Texas Coastal Management Program

Publications of the Texas Coastal Management Progra

Existing Data: An Annotated Bibliography of Researc
Present Authority: Authority of Governmental Entitie
Public Participation: A Report of Public Participation,
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Conducted by
RPC, Inc.
RON JONES, DIRECTOR

TEXAS COASTAL MANAGEMENT PROGRAM

REPORT TO THE GOVERNOR AND THE 65TH LEGISLATURE

General Land Office of Texas

Bob Armstrong, Commissioner

NOVEMBER 1976

This program is funded in part through financial assistance provided by the Coastal Zone Management Act of 1972, administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration.

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The contents of this report have been reviewed by the Texas Coastal Management Program Advisory Committee, and the program staff has considered their comments. The report does not necessarily reflect their views, however, and the staff of the Coastal Management Program assumes all responsibility for its contents.

General
Land Office
AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

November 1, 1976

The Honorable Dolph Briscoe
Governor of Texas
Austin, Texas 78711

Dear Governor Briscoe:

In response to your request and designation, I began in June of 1974 to lead an effort on behalf of all the state's natural resource agencies to develop a coastal management program for Texas. This volume presents recommendations for an improved coastal management process. These appeared in draft form in June and were the subject of ten public hearings in August and September. Following these hearings, the recommendations were revised and amended, and they appear here in their final form for consideration by you and the 65th Texas Legislature.

In order to develop recommendations that were responsive to the needs of all the people of Texas, I appointed a 41-member advisory committee whose diverse viewpoints and experience represented virtually all the major interests along the Texas coast. I have consulted them frequently, and they have given generously of their time and effort to discuss and criticize our work. Considering the diversity of their perspectives on the Texas coast, I have been pleasantly surprised by how well they have worked together to discuss many difficult issues. I am also gratified that, despite their differences, they are nearly unanimous in supporting the recommendations presented in this document.

I believe that all the people of Texas will benefit from the recommendations and therefore look forward to their implementation.

Yours truly,

Bob Armstrong

Bob Armstrong, Commissioner
GENERAL LAND OFFICE

ACKNOWLEDGMENTS

At the request of Governor Briscoe, the General Land Office of Texas has led the state's efforts to develop an improved coastal management process. Under contract to the General Land Office, RPC, Inc., of Austin, Texas, has provided the following professional staff for the program:

Ron Jones, Director
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Assisting in the program from the General Land Office staff were:

John D. Macklin, Jr., Acting Director, Planning Program
W. D. "Red" Oliver, Special Projects Assistant
Robert W. Waddell, Head, Staff Support Operations Division

Ruth Kent, Muriel Wright, Nick DeGeorges, Linda Hill, Lou Hill, Carolyn Brown, Eleanor Dailey, Gwen Craddock, Lyn Verdery, Mary Frances Moreno, and Michele Hester.

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PREFACE

This document presents the recommendations developed by the Texas Coastal Management Program. The objectives of the program are to develop and recommend to the governor and legislature by January, 1977:

1. an improved and flexible policy-planning process which will ensure a continuing balance among future economic, environmental, and social needs along the coast, and
2. the steps for implementing such a process.

Public hearings on these recommendations were held according to the following schedule:

Monday, August 9 ..... Brownsville
Fort Brown Hotel

Wednesday, August 11 ..... Corpus Christi
Emerald Beach Holiday Inn

Friday, August 13 ..... Victoria
Victoria Bank & Trust Building

Monday, August 16 ..... Bay City
Service Center

Wednesday, August 18 ..... Houston
Marriott Motor Hotel

Friday, August 20 ..... Galveston
County Courthouse

Monday, August 23 ..... Beaumont
Red Carpet Inn

Wednesday, August 25 ..... Dallas
Marriott Motor Hotel
Stemmons Freeway

Monday, August 30 ..... San Antonio
El Tropicano Hotel

Wednesday, September 1 ..... Austin
Stephen F. Austin
State Office Building

Public commentary received at these hearings through the program advisory committee and through letters to the program staff was reviewed and taken into consideration in preparing these final recommendations for submission to the governor and to the legislature.

Copies of this report and of the hearing transcripts have been placed in the State Library in Austin and in public libraries throughout the coast. While supplies last, copies of these and other Coastal Management Program documents are available free of charge from:

Texas Coastal Management Program
General Land Office
1700 North Congress Avenue
Austin, Texas 78701
(512) 475-6902

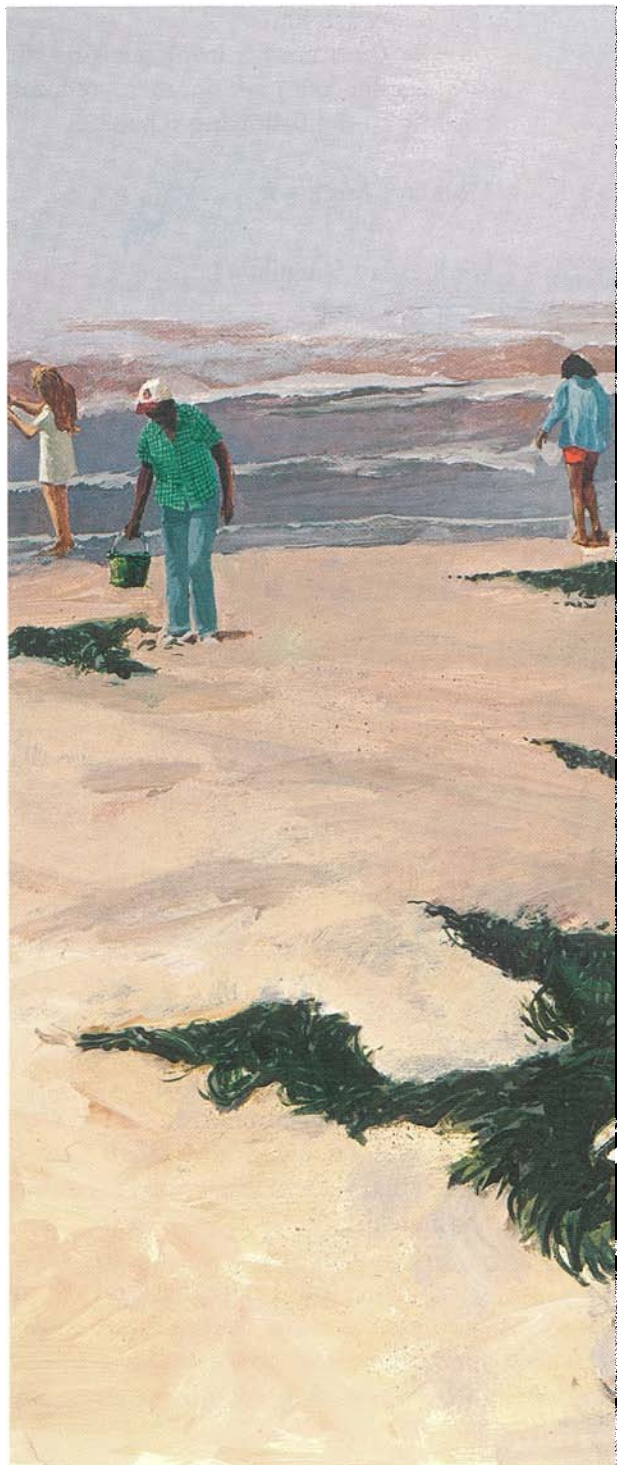
Rapid growth in the Texas coastal area has placed increasing pressures on the complex natural systems that support many human activities and has created conflicts over the allocation of coastal resources. As more conflicts arise, it becomes increasingly apparent that the limited natural resource base is threatened, and choices must be made. As owner-manager of vast coastal public resources and as protector of the public interest, government must devise and implement a rational process for resolving use conflicts. The process should maintain the delicate balance among the economic, environmental, and social forces that sustain human well-being; and it must remain flexible enough to respond to new information and changing perceptions of human needs.

The Texas Coastal Management Program was initiated in June of 1974 as a joint project by the state's natural resource agencies to devise a flexible policy-development process to maintain this balance. Leading the state's efforts at the governor's request, the General Land Office obtained funding under the federal Coastal Zone Management Act of 1972. The federal act is not mandatory, but it does offer guidelines within which each state may receive funds to develop a coastal management program tailored to its own needs and unique coastal problems. In addition, the act provides to a state that develops an acceptable management program the incentive that most future federal activities in that state's coastal area will be required to be consistent, as far as is practicable, with the state's approved program.

After an extensive survey of existing resource data and current governmental authority for coastal management, a comprehensive inventory of Texas coastal resources, a study of current and projected economic activity, and an intensive public participation program, the Coastal Management Program has developed recommendations for a process to resolve future conflicts in resource use. This volume presents:

- —the bases for the state's concern regarding Texas coastal waters and adjacent shorelands;
- —the various local, regional, state, and federal authorities now managing coastal resources;
- —documentation of coastal problems judged to be both important and proper objects of state concern;
- —the program's conclusions and recommendations for improving the present management process; and
- —a review of the advantages and disadvantages associated with these proposed changes.

A second volume contains a set of appendices which provide further documentation of extremely complex areas of concern and a detailed explanation of the activity-assessment routine and other recommendations that are part of the proposed management process.



INTRODUCTION

OVERVIEW

Public Interest in the Coastal Region

The Gulf Coast of Texas is a major contributor to the prosperity and well-being of both the state and the nation. It concentrates a third of the state's population and economic activity into a tenth of the state's land area. It houses 40 percent of the nation's petrochemical industry and over 25 percent of the nation's refining capacity. In 1972, its combined agricultural and fishery production exceeded $700 million, and its 2,500 miles of shoreline brought nearly 10 million visitors to the state.

The petroleum, petrochemical, and agricultural sectors rely heavily upon Texas ports and waterways for transportation of their products. Three-fourths of all the goods shipped from Texas to other states travel by water. Of the 10 deepwater ports in Texas, the Port of Houston, the combined ports of the Sabine-Neches waterway, and the Port of Corpus Christi are among the largest in the nation. The Gulf Intracoastal Waterway, which reaches from Texas to Florida and extends 426 miles along the Texas coast, carried more than 66 million tons of cargo in 1974.

The population and economy of the Texas Gulf Coast have grown rapidly over the past decade, and this growth rate is expected to continue. Growth will be concentrated in urban industrial areas such as the Houston-Galveston complex, where 80 percent of the population growth of the Texas coast is predicted to occur.

The natural systems of the Texas coast are interdependent, and they are closely tied to the coastal economic and social systems. Coastal issues, too, are bound together—jobs with livability, housing with agriculture, wetlands protection with water transportation.

Although continued coastal growth and development is probable, it is not assured, for the coast's ability to supply the resources needed for continued increases in productivity is uncertain. Problems have already arisen that, unless checked, will limit economic growth. These problems include increasing exposure of residents to natural hazards and shortages of fresh water for agriculture, industry, municipalities, and the bays and estuaries.

In recent years the public has become more aware of coastal problems and less willing to live with them. In the many public meetings held by the Texas Coastal Management Program along the Gulf Coast, coastal residents have expressed their concern about a number of problems that result from conflicts over use of the natural resource base. They have made it clear that they expect solutions, and when the problems are greater than local in scope, many residents look to the state to provide answers.

CHAPTER I
BASES FOR CONCERN

The state is responsible for promoting prudent and environmentally sound development of the Texas Gulf Coast. This responsibility derives from several sources. First, the state owns much of the coastal resource base—most of the submerged lands and tidelands, surface waters, and fish and wildlife. Second, the state is a major investor in public facilities such as ports, parks, and recreation areas; and third, the state regulates the uses of many of the natural resources associated with coastal waters and adjacent shorelands. For these reasons, state processes to weigh and balance policies for these coastal responsibilities have been designed.

The resource focus of the Texas Coastal Management Program is coastal waters and adjacent shorelands. Coastal waters are defined as all tidally influenced waters containing a measurable amount of seawater from a changeable shoreward boundary of mean high tide seaward to the limit of state-owned waters, 3 leagues (10.35 miles) out in the Gulf of Mexico. These coastal waters include Gulf shorefaces and offshore areas, bays, lagoons, tidal inlets, river mouths, coastal lakes, and tidal streams. They interact directly with shorelands that include transitional and intertidal areas, beaches, salt marshes, wetlands, spoil islands, washover areas, and active dune complexes.

The public has a strong interest in the Texas coastal region because its abundant resources support many human demands (fig. 1). The coastal waters and shorelands contain many and varied resources. Historical and archaeological sites, most of which are still unexplored, lie submerged in state waters. Petroleum is extracted from submerged lands and other coastal areas. The waters abound in finfish and shellfish, which support an important commercial fishing industry. The fish, waterfowl, and other game bring hunters and sportfishermen to the coast.

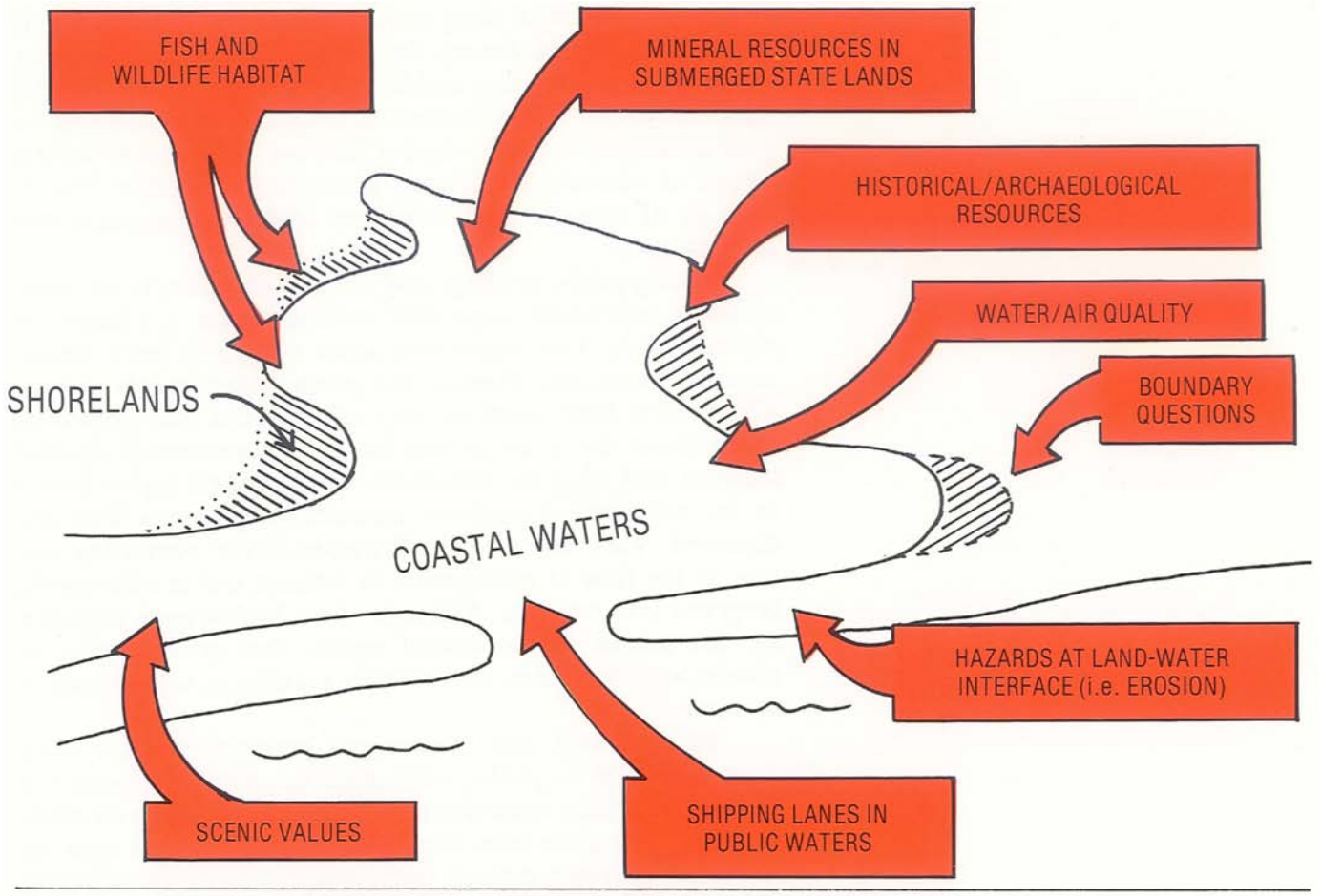
The coastal waters and shorelands are themselves a great resource. The large coastal tourist industry depends not only on a diversity of fish and wildlife, but on scenic views, open beaches, wetlands, and clean air and water. Public waters support waterborne transportation and furnish access to ports and channels. Deepwater ports open vast markets for goods, thus encouraging high levels of industrial, commercial, and agricultural productivity throughout the state. All these uses of coastal waters support public well-being and private enterprise.

Because coastal waters are largely a public resource, they are logically the main focus of the state's involvement in coastal management. The state must manage its own holdings; to do otherwise would violate the public trust.

The principal issues that should be addressed by a coastal management program are those related to the public and private demands made on coastal resources and to the natural processes that are intimately associated with the waters and shorelands.

Some governmental authority is exercised over activities both on the uplands and in coastal waters (fig. 2). Many public concerns, like many private activities, are in no way dependent on a proximity to coastal waters. Residential development, agri-

Figure 1
PUBLIC INTERESTS CENTERING ON COASTAL WATERS



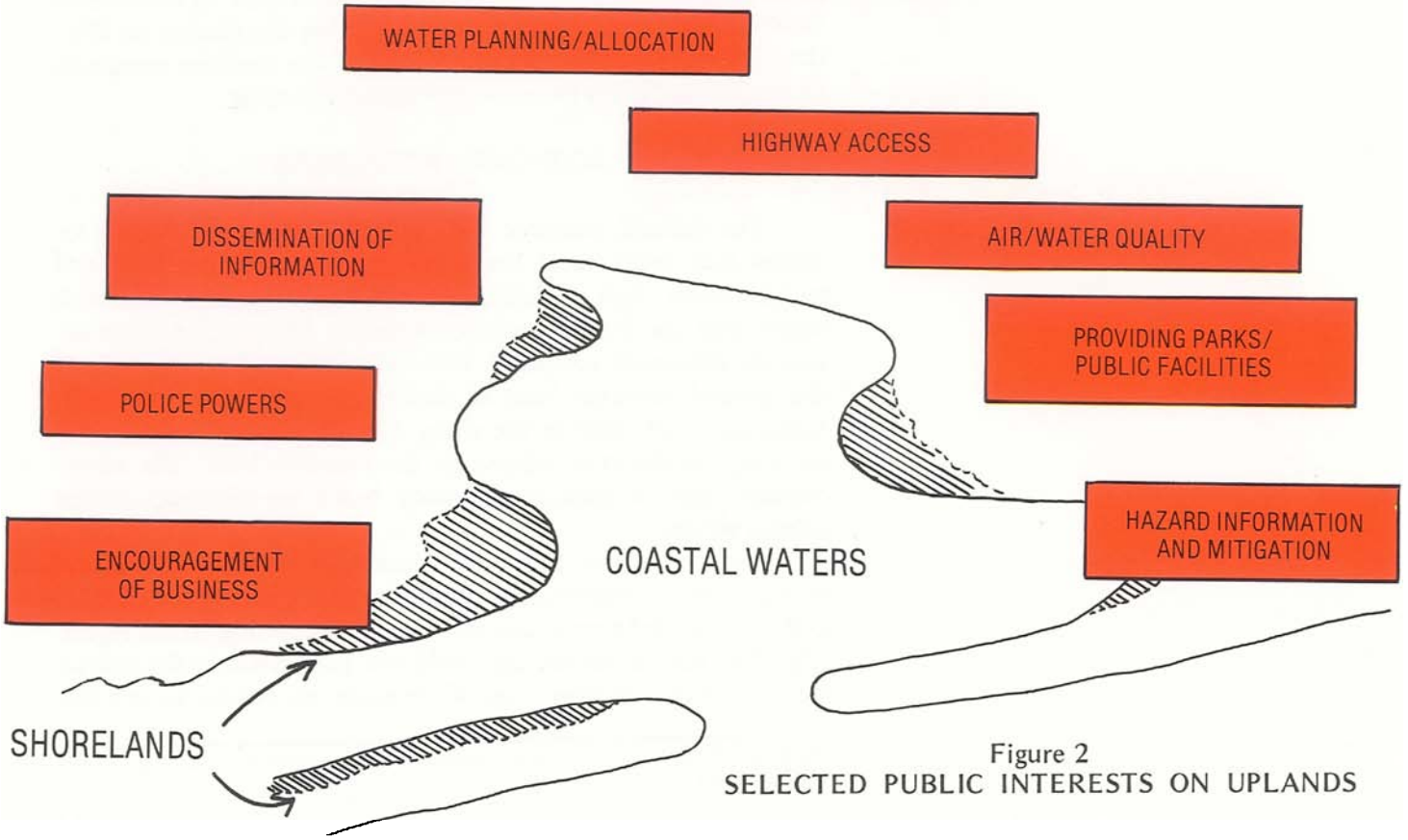


Figure 2
SELECTED PUBLIC INTERESTS ON UPLANDS

culture, and industrial siting are of concern to this program only when they compete directly for the products of coastal waters, threaten the continued availability of the resources contained in these waters, or create hazards to coastal residents. Likewise, road construction, park planning, and law enforcement are not always of concern to a coastal management program. That is, they are of concern only where they impinge on coastal waters or shorelands.

During public meetings held in cities along the Texas coast, residents repeatedly expressed concern about a number of coastal issues. Two issues mentioned frequently were coastal hazards (hurricanes, erosion, and ground subsidence*) and the allocation of fresh water to bays and estuaries. Questions were raised about the value of wetlands, the placement of dredged material, and what the boundaries of the coastal region should be for management purposes. Institutional problems were also discussed. They included inefficiencies in the permitting process, in the flow of information to citizens, and in other public programs and policies. Although these institutional problems are not unique to the coastal region, they affect coastal resources and were seen by residents as being in urgent need of solution.

These coastal and institutional problems are not being dealt with now to public satisfaction by either government or the private market system. Recurring problems can be classified as falling into three main categories: those associated with the economic activities derived from coastal waters, those arising from conflicts over the use of the resource base of the coastal waters and shorelands, and those affecting the quality of life—the "livability" of the coastal region. These problem categories comprise the "bases for concern" about the coast.

ECONOMIC RESOURCES

The natural resource base within the coastal region includes rich agricultural lands, mineral resources on land and within water, fish, wildlife, undisturbed natural areas, fresh water, and the coastal waters. Society's demand for these resources generates economic activities that make direct use of the natural resource base or derive indirect benefits from it. Some activities, such as the siting of a government installation, are only incidentally related to the resource base. The major concern here is economic activity based on resources within coastal waters.

There are three economic sectors that depend directly on coastal waters: waterborne transportation, commercial fishing, and most of the recreation and tourism occurring in the region (fig. 3). These three sectors could not exist without the coastal waters. Other activities (fig. 4) impinge on coastal waters but

*Sinking of the land caused by extraction of groundwater at a rate that depletes the supply.

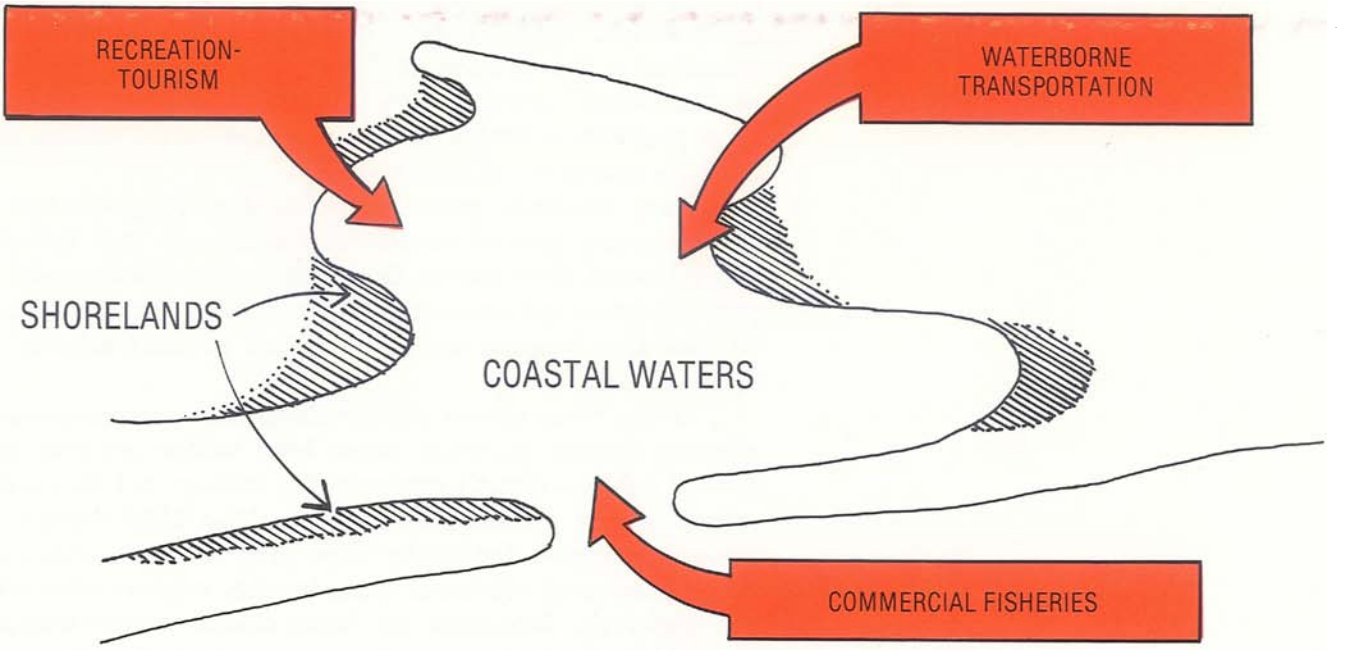


Figure 3
ECONOMIC SECTORS THAT DIRECTLY "BID"
FOR GOODS FROM COASTAL WATERS

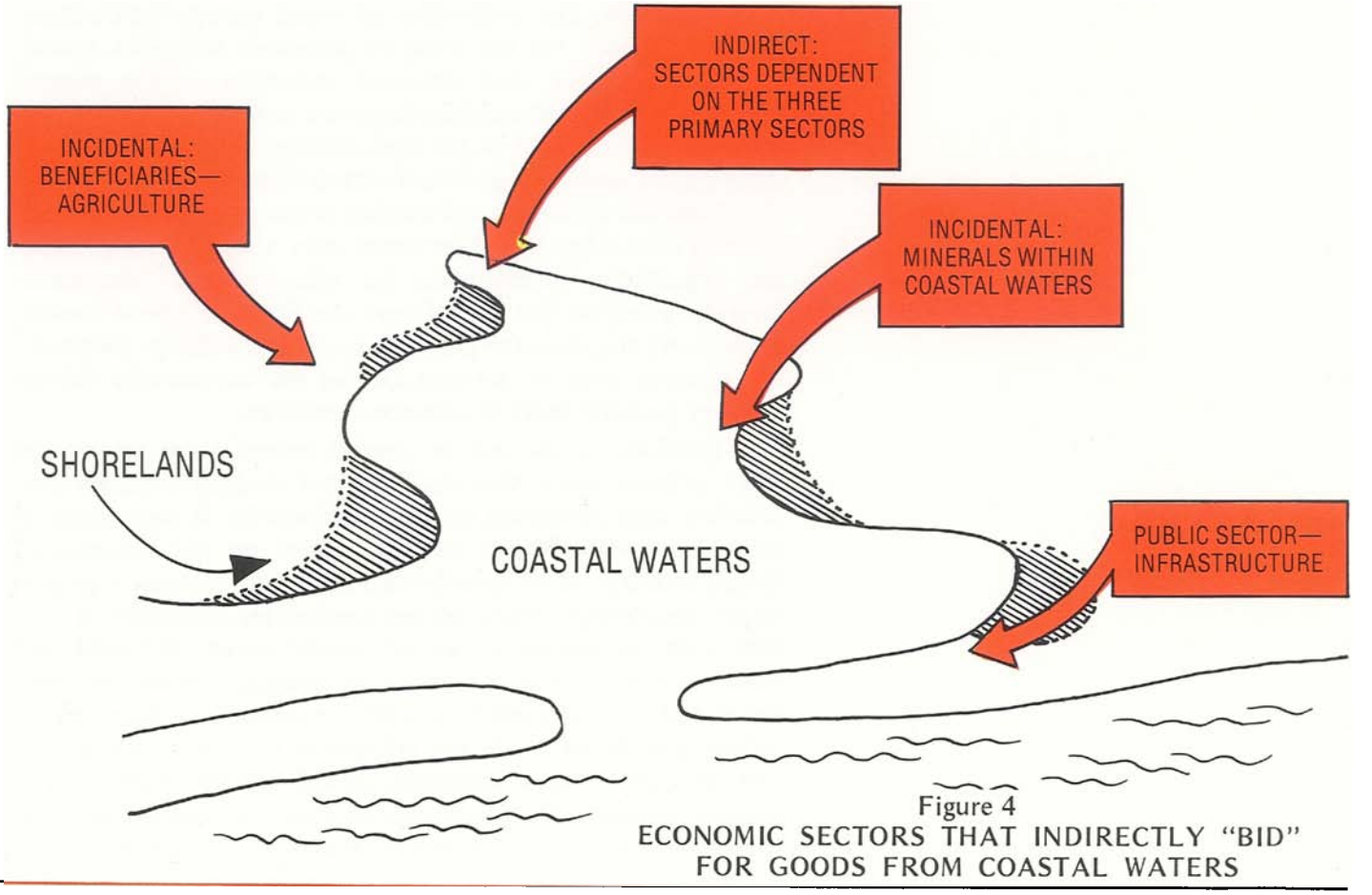


Figure 4
ECONOMIC SECTORS THAT INDIRECTLY "BID"
FOR GOODS FROM COASTAL WATERS

are not directly dependent on them. Oil and gas, for example, are produced within coastal waters, but the waters are only incidental to the location of these resources. Agriculture is also an "incidental" activity, although both agriculture and petroleum production benefit from being close to the waters, especially for access to transportation.

Many economic sectors are secondary outgrowths of the three primary uses of coastal waters and are thus indirectly dependent on these waters. Governmental activities support the private sectors and encourage further coastal economic growth by providing facilities and services, such as roads, schools, and some utilities.

Of the three sectors directly dependent on coastal waters, shipping directly generates about $448 million per year, commercial fisheries directly generate $85 million, and the outdoor recreation and tourism sector adds at least $585 million. The amount generated directly by these three sectors is only a portion of their total economic value, for they support other activities—indirectly dependent on Texas coastal waters—that have economic effects throughout the state and the rest of the nation. The coastal transportation sector's total economic impact is over $1.6 billion annually. The fisheries sector generates a total of $350 million per year. The estimated total annual economic impact of outdoor recreation is more than $2 billion.

Waterborne transportation generates major indirect economic benefits. The availability of water transportation is an important reason for the siting of petroleum refineries, metallurgical complexes, and chemical industries in the coastal region. The maritime shipping lanes are valuable to agricultural activities as far upland as the high plains and beyond, for they open world markets to grain and cotton farmers.

Both the recreation and tourism sector and the commercial fisheries sector, the two other direct users of coastal waters, also have significant consequences for other areas of the state. Tourists going to the Gulf Coast, for instance, spend money throughout the state for gasoline, food, and lodging. Likewise, the onshore support services serving the commercial fishing industry generate indirect economic activities.

Conflicts in the use of coastal waters occur among the three primary users. Port facilities and dredged channels that interfere with continued biologic productivity in some parts of the coastal waters have adverse effects on the commercial fishing industry or on sportfishing. Likewise, aesthetic considerations that benefit recreation and tourism are sometimes in conflict with the intensive uses of coastal waters for ports and waterways. Economic sectors on the uplands compete for fresh water and for space either directly or indirectly. These sectors include petroleum producers, refiners of petroleum and chemicals, and other heavy industries, as well as agriculture and the housing industry. The freshwater demands of these sectors may reduce the inflows of freshwater, sediment, and nutrients that

are vital to natural ecosystems. Wetlands or other areas necessary for the continued biologic productivity of the coast are often destroyed.

Some uses of coastal resources are conspicuously profitable; others are not. If coastal waters are considered only in terms of present dollar values, then developmental uses may win out over the maintenance of long-term continued natural productivity. The amount of money generated by intensive uses of coastal waters for shipping and derivative activities may locally exceed the amount generated by commercial fishing or recreation and tourism. Taxes alone paid by the chemical and refining industries along the Texas coast are more than three times greater than the total revenues generated by the Texas shrimping industry. This does not mean, however, that the biggest revenue producers have the right to use or abuse coastal waters as they please. Many benefits of coastal waters are provided if, and only if, the natural biologic, chemical, and physical processes continue to operate. Many "natural" values are not accounted for in the market system, nor can dollar values be assigned to social preferences regarding aesthetics, open space, access to beaches and waters, air and water quality, and other social values (fig. 5).

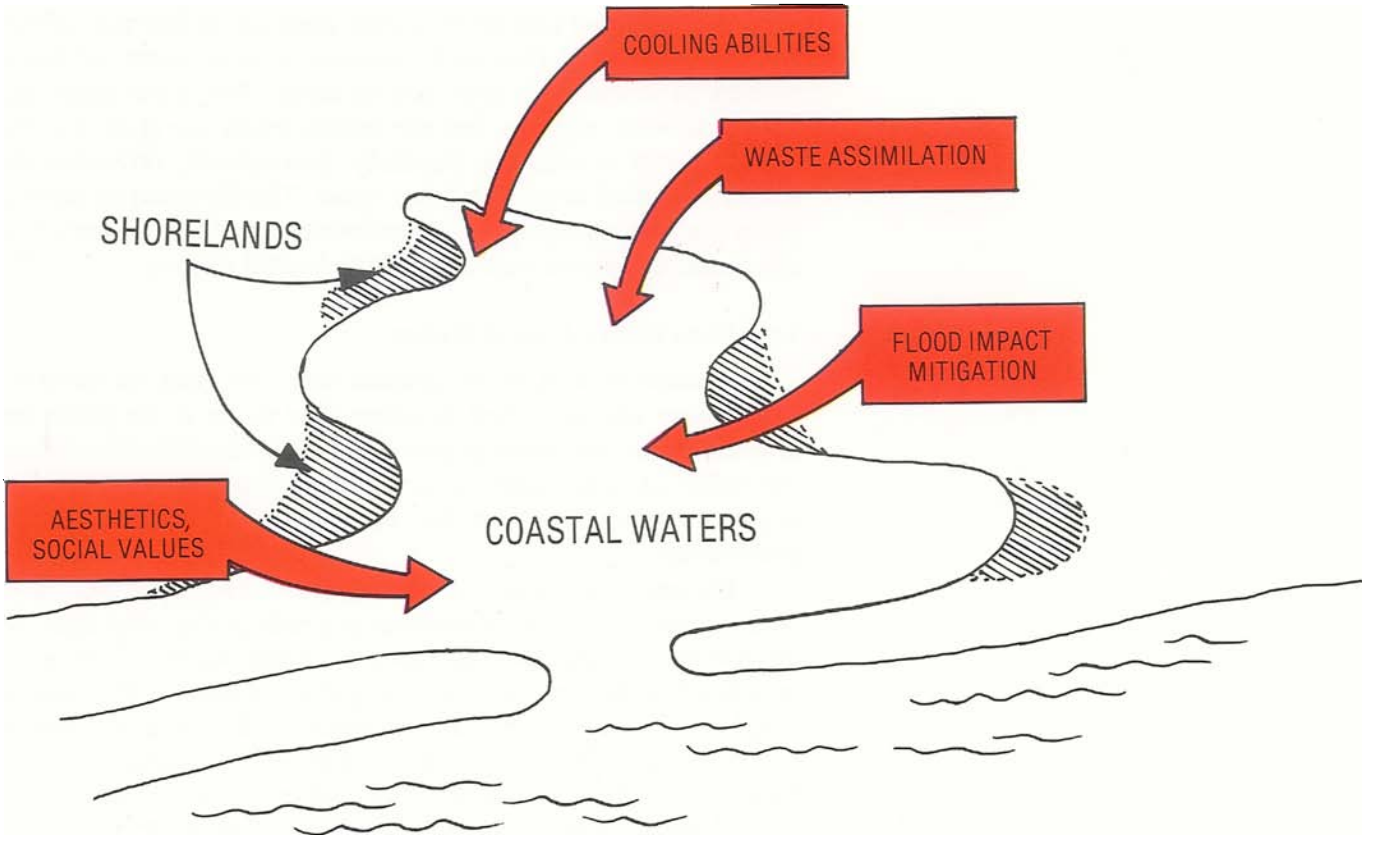


Figure 5
NONMARKET VALUES OF COASTAL WATERS

NATURAL RESOURCES

The abundant natural resources of the coastal region contribute to both economic development and the attractiveness of the coast as a place to live. The economic activities based on these natural resources affect the coastal waters and shorelands in many ways: by diverting freshwater supplies from the bays and estuaries; by encroaching onto wetland space; by producing goods that require shipping lanes and thus dredging and the disposal of dredged material; and by creating a demand for public roads and waterways and for other public facilities.

Resources on Coastal Uplands

Upland resources include the fertile soils, wide-open spaces, and fresh water within one of the nation's most productive agricultural belts. Minerals, particularly oil and gas, found on the uplands help make Texas the primary mineral producer in the nation. The coastal region has plentiful land on generally secure, stable terrain that can support intensive use by such sectors as heavy industry without crowded conditions or widespread adverse environmental impacts. These upland resources are certainly important to the economic well-being of Texas and the nation. Their use, however, generally does not *directly* impinge on the coastal waters; therefore, most upland activities are not addressed by the Coastal Management Program.

Some upland natural resources have limits that may affect the coastal waters. One such resource is fresh water, which is needed to sustain the bays and estuaries. The upper coast has adequate water supplies, but the farther south one goes, the less surface water is available. Similarly, groundwater resources are not as abundant along the lower coast. The diversion of surface water or the pumping of groundwater can have indirect but significant effects on resources of the coastal waters.

Variations Within Coastal Waters

Because man is more familiar with the land, he takes its variety into account when deciding how to use it. He plants his crops in fertile soil when possible, not on rocky hills. He realizes the value of crop rotation and knows that the land can be depleted by overuse, but that used wisely it will sustain him indefinitely.

Because man cannot see beneath the water's surface, he is often unaware of the differences in productivity, and thus of differences in value from one area of coastal waters to the next. It seems that before man can recognize the value of the coastal waters in the same sense that he understands the capabilities of the land, he must experience a reduction of desired products from those waters as a result of unwise resource use. It is unfortunate that a resource crisis may be necessary to encourage awareness of the values and differences in various types of coastal waters.

Not all areas of coastal waters yield the same products in the same quantities, nor do they need the same ingredients to sustain them. Oyster reefs, tidal passes, submerged grass areas, tidal flats, and marshes differ from one another, although these areas are interconnected and affect one another. Each has distinct characteristics, requirements, and value to man.

The beach and shoreface area of the open Gulf, for example, is characterized by shallow water with strong waves that stir up sediments and separate out fine-grained materials. The life forms of this environment are neither numerous nor especially diverse, but its aesthetic and recreational aspects are highly valued by society. This value makes it important for man to understand coastal processes—in this case, why and how beaches are maintained and replenished.

Tidal marshlands, in contrast to beach and shoreface areas, are characterized by little or no direct wave impact. They are low-lying areas influenced by tidal ebbs and flows, as well as by periodic freshwater inflow which carries nutrients and sediments. These influences combine with sunlight to yield the salt-tolerant grasses that are the basis for a food chain consisting of many organisms. Shrimp, blue crab, speckled trout, drum, redfish, and various waterfowl are only a few of the commercially important species that periodically inhabit the marshes. In addition to serving as a nursery ground for the Gulf fisheries, marshes act as nutrient cycling systems that cleanse waters which have been polluted by human uses. Marshes also serve as natural flood basins, reducing the impacts of storms.

Tidal inlets or passes provide access between the open waters of the Gulf and the bays and wetlands. They are formed and maintained by the ebb and flow of tides and the passage of storm surges. The inlets are passageways that control the exchange of waters, sediments, and life forms that make up the marine food chain. The natural tidal inlets are delicately adapted to the amount of freshwater and sediment inflow that comes to the bays from the uplands. Freshwater runoff from storms flows through the inlets, periodically flushing and cleaning the whole bay system. Flushing activity can be lessened when freshwater inflow to the bays is decreased or when water circulation patterns are modified. This is harmful to migrating life forms and reduces the ability of these tidal channels to maintain themselves. Although tidal inlets and passes do not sustain a high level of biologic productivity, they are critical to the migration of marine organisms that are harvested by the Gulf Coast shrimpers, other commercial fishermen, and sport-fishermen.

Composite Resource Areas of Coastal Waters

Beach and shoreface areas, marshes, and tidal inlets are only three of many "composite resource areas" of coastal waters. These resource areas, which may be either natural or man-made, are defined by local characteristics of processes, sub-

strate, landforms, soils, biota, or other factors. Each type of composite resource area has its own characteristic abilities to support certain levels of human activities without appreciable environmental harm or human hazard, and all composite resource areas of a given type have similar abilities to support specific uses. Each type of composite resource area can be described in terms of its "sustaining parameters," that is, specific energy and material inputs, products, and characteristic features which, in combination, make that area a functional unit. Resource areas are also interconnected by movements of materials, organisms, and energy. The natural flows and static conditions that connect or delineate most resource areas include fresh water or salinity, the sediment and nutrients carried by the water exchanges, bathymetry, substrate, biotic assemblages, and species migrations (table 1).

The composite resource area concept is fundamental to the program's recommendations for improved coastal management. These areas do not dictate prescribed uses, nor do they indicate a zoning of the coast. They simply reflect the differences in lands and waters from place to place and thereby help a decision-maker to understand and anticipate some of the consequences of a specific activity in a given location. Stony, hilly uplands and prairie lands are two kinds of upland resource areas; marshes and wind-tidal flats are two of the resource area types found within coastal shorelands.

In their natural condition marshes may simultaneously serve man as sources of food, as waste treatment facilities, and as flood basins. But marshes can also be used in other ways, and some of the products harvested from marshlands can be produced in other resource areas by means of aquaculture (marine farming). This would, however, take a considerable expenditure of effort and energy, as has been required to make marginal agricultural land productive. Such practices may be necessary if no alternatives exist, but they are expensive, and the costs should be understood. Examining what makes up resource areas is the first step in this process, because it shows what specific areas can sustain in their natural condition.

The composite resource areas cover both coastal waters and shorelands as indicated in figure 6 and table 1.

The degree of precision with which composite resource areas can be delineated is partly dependent on the scale of the maps on which the areas are presented. Because the focus of this program is regional, an effort has been made to simplify coastal systems into these 18 units (plate 1). However, each unit could be subdivided further in a site-specific context if a map scale large enough to allow a more detailed examination were used.

Figure 6
COMPOSITE RESOURCE AREAS OF
COASTAL WATERS AND SHORELANDS

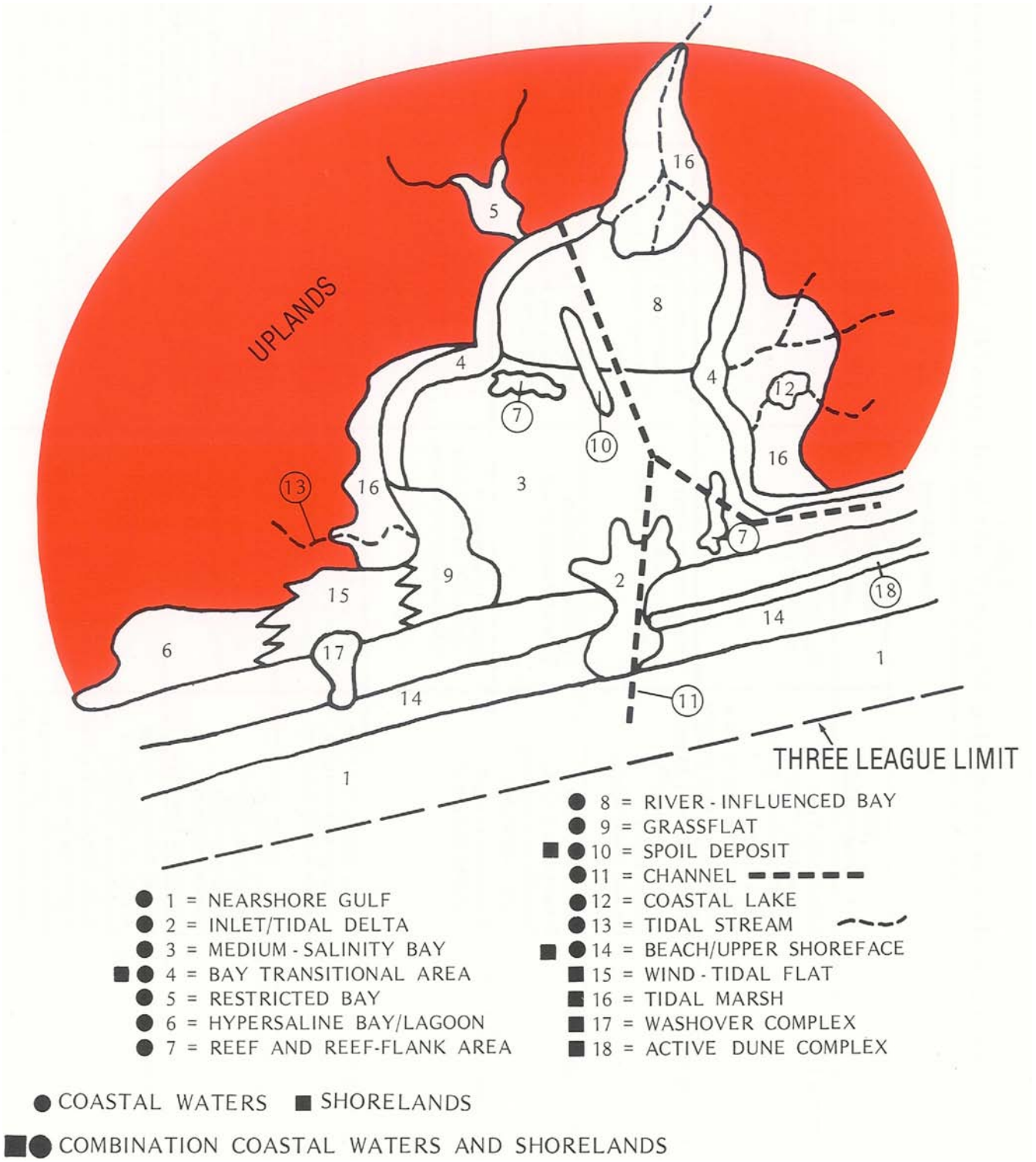


Table 1
CHARACTERISTICS OF COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND SHORELANDS

Coastal Waters				
	Water Characteristics	Water Movement and Circulation	Bathymetry, Morphometry, Substrate	Biota
1. Nearshore Gulf	Salinity 30-35 ppt Temperature 12-32°C Turbidity variable—lower than surf zone More nutrients than in open ocean, less than in bay area	Currents large-scale, slow, parallel to shore	Depth 15 to several hundred feet Little relief Substrate mud with sand	Diverse plankton, benthos Numerous predacious fishes High species diversity
2. Inlet/Tidal Delta	Variable salinity, 1-35 ppt Temperature 10-35°C High turbidity Possibly much organic material	Strong currents, waters possibly stratified Sediment transport area	Often corresponds with channel (to 40 ft. deep) Substrate variable; mud, sand	Diverse fauna adapted to high current energy or migrating forms (fluctuating biomass)
3. Medium-Salinity Bay	Salinity 10-35 ppt Temperature 1-35°C Turbidity and nutrients vary considerably	Complex circulation Waters vertically mixed	Depth, 6-15 feet Usually low bottom relief Mottled mud	Various plankton 4-5 level food chain Diverse biota
4. Bay Transitional Area*	Characteristics highly variable, site-specific	Movement of water is dependent on the nature of adjacent resource area	Shallow, often less than 3 feet deep Substrate sand to mud, sandier where currents are substantial; includes berms and bayside beaches	Sparse sea grasses Seasonal high concentration of juvenile organisms; otherwise, similar to adjacent area
5. Restricted Bay	Salinity usually 10-33 ppt, although quite variable Possibly low 0_2 concentration	Little tidal influence Circulation poor except for strong wind, storm tides	Shallow, 3-8 feet Restricted outlet Rich mud substrate	Reduced species diversity Sparse sea grasses Most species similar to medium-salinity bay
6. Hypersaline Bay/Lagoon	Salinity 30-60 ppt Temperature 0-40°C Turbidity variable Nutrients often high Unusual ion concentrations	Circulation often wind-dependent Restricted circulation	Depths to 12 feet Lagoons usually long, narrow, parallel to shore Complex substrate	Usually lower species diversity Some sea grasses Blue-green algae Abundant molluscs
7. Reef and Reef-flank Areas	Salinity 0-35 ppt, though higher on serpulid reefs Temperature 10-35°C Usually significant levels of organic materials Higher salinities and temperature associated with serpulid reefs	Often associated with well-established currents	Depth 0-8 feet Usually perpendicular to circulation Characteristic substrate of shell debris and mixtures of mud to sand	Diverse system Besides oysters, many other invertebrates are present which attract carnivores from nearby areas Includes serpulid reefs on lower coast

	Water Characteristics	Water Movement and Circulation	Bathymetry, Morphometry, Substrate	Biota
8. River-influenced Bay	Salinity 0-10 ppt Temperature varies, esp. with inflow Turbidity usually high High concentrations of nutrients	Often well-defined circulation toward Gulf Salinity gradients sometimes exist	Depths 3-7 feet Large sediment flux Normally smooth bottom Sediments rich in organic material, laminated near deltas, mottled further away	Fluctuating populations of juveniles, otherwise low number of species Turbidity may limit 1^{o} (primary) production
9a. Grassflats (Hypersaline)	Except for reduced turbidity, characteristics are those of hypersaline lagoons	Wind-related movements Waters well mixed Currents low to moderate	Occur in shallow lagoon or bay margin Depth 1-4 feet Soft, smooth bottom Substrate is rich in organic matter; sand with mud and shell	Greater diversity than lagoon Algae, many epiphytic Abundant molluscs Carnivorous fishes tolerant of salinity levels
9b. Grassflats (Moderate salinity)	Similar to those of adjacent areas Reduced turbidity Grasses contribute to organic matter	Partial reduction of wave action by grass More tidally influenced than hypersaline grassflats	Depth 1-5 feet Often coincident with bay margin Rich mud to muddy sand with some shell deposits	Very diverse system Numerous species (similar to hypersaline) from 1^{o} producers to large fishes Complex trophic structure
10. Spoil Deposits*	Potentially very high turbidity Many water parameters altered during active spoil placement	Complex circulation Deposit may block circulation or direct flow; therefore current speed is variable	No characteristic depth All morphological characteristics are site-specific May be emergent "spoil islands"	No indicative community Faunal assemblage usually from nearby resource area Burrowing invertebrates are first colonizers of new sediment Spoil islands may be important rookeries
11. Channel	Often high turbidity Distinct salinity, temperature gradients Effluents may be considerable	Rapid water flow Flow may be stratified Net direction of flow is usually Gulfward but can vary	Deep, to 45 feet Steep sides Hard-packed substrate cleared of sediment in areas of high flow Otherwise, silt or fine sand	Similar to inlet/tidal delta Most life forms either burrow, attach to hard substrate, use channel as migration route, or are planktonic Large seasonal fluctuations in biomass
12. Coastal Lakes	Water features are similar to tidal marsh Salinity, temperature, and oxygen may be more variable	Subject to tidal, wind-tidal, and stream flow influences Circulation may be complex, depending on connections to marsh	Shallow depressions in tidal marsh drainage system Substrate sand to mud, high organic content Blue-green algal mats may be layered on bottom	Consumers similar to those of tidal marsh Density may be lower than in tidal marsh Marsh plants sparse, may be supplemented by blue-green algal mats

	Water Characteristics	Water Movement and Circulation	Bathymetry, Morphometry, Substrate	Biota
13. Tidal Stream	Extremely variable parameters Turbidity and nutrients usually higher than other resource areas Salinity, 0.5 to 35 ppt, with salt derived from marine waters Oxygen often below saturation Ion concentrations may be unusual and variable Effluents may be high	Net water movement is toward bay, with frequent tidal influence and mixing of fresh and estuarine waters Waters well mixed, no distinct salt wedge	Depth varies, 4-40 feet Usually meandering streams Watercourse often altered by erosion and accretion Sandy substrate characteristic of high flow; mud layer indicative of lower current flow	Biota quite variable, depending on salinity Species range from freshwater species to those typical of estuarine areas Turbidity limits phytoplankton productivity Some marsh plants may appear

Shorelands*

	Water Characteristics	Water Movement and Circulation	Bathymetry, Morphometry, Substrate	Biota
14. Beach/Upper Shoreface*	Salinity 20-35 ppt Temperature 9-35°C High turbidity Considerable organic matter	Strong wave action Strong currents keep beach sand and shoreface sediments in motion	High tide swash zone to 15 feet depth Series of sand bars (shoreface) Sandy substrate Partially submerged	Small interstitial inhabitants Larger benthic invertebrates Predators (fishes and birds)
15. Wind-tidal Flat	Characteristics indicative of adjacent resource area Subject to temperature extremes Turbidity and nutrients variable, can be high	Circulation wind- and/or tide-dependent Movement generally perpendicular to shore Waters well mixed	+2 to -1 mean sea level (MSL) Very low relief Sand substrate with mud depressions Sediments rich in organic matter	Blue-green algae (1^{o} producers) Numerous invertebrates occupying substrate Omnivores and carnivores move in and out with water
16. Tidal Marshes (including salt marshes, brackish-water marshes, and fresh-to-brackish-water marshes)	Subject to tidal influence Salinity ranges from almost marine to fresh High nutrient levels Turbidity variable (with tidal cycle)	Frequent or occasional inundation and flushing through tidal channels	Mean low tide to +3 feet above mean low tide Accreting areas of bay margins or connecting inland areas Sand to silt substrate	Vascular marsh vegetation is characteristic Large amounts of decayed plant matter form basis of food chain Bacteria and other decomposers are important Functions as nursery ground for many species
17. Active or Potentially Active Washover Complex	Ephemeral pools of fresh or salt water may occur Evaporation may concentrate nutrients or salts	Not applicable	0 to 5 feet above MSL Usually narrow connection from bay to Gulf during high water Substrate is sand and local mud with a moisture range of 4 to 20%	Extent of plant life may depend on salt content Burrowing crustaceans and sand dwellers typical of higher beach Standing water may contain many characteristic marsh species

*May be either coastal waters or shorelands

	Water Characteristics	Water Movement and Circulation	Bathymetry, Morphometry, Substrate	Biota
18. Active Dune Complexes (Gulf Shoreline)	Not applicable	Not applicable	Heights range to 40 or 50 feet Perpendicular to prevailing wind Substrate fine to very fine sand Low moisture, mineral and nutrients content High permeability	Vegetation sparse except on stabilized blow-out dunes Plant species diversity limited Transient terrestrial animals residing in adjacent areas

LIVABILITY

"Livability" is defined by the qualities that make an area a *good* place to live. A "livable" place offers more than the satisfaction of basic necessities. The livability of the coastal region is one reason many people choose to live, work, and visit there.

For a place to be livable, it must offer a balance between continuing economic opportunities and other assets, not all of which are adequately taken into account by the marketplace (fig. 7). Probably the most important resource in the coastal region is an adequate freshwater supply of unpolluted surface water and groundwater that can be produced without adverse effects. Fresh water is the limiting natural resource in the coastal region. The upper coast is well watered; its rivers have abundant flow. Farther south, however, streamflow decreases and groundwater supplies are thought to be inadequate for large-scale pumping.

Other assets to livability include a pleasant climate, clean fresh air, open spaces, beaches, and fishing and hunting opportunities. These are not only valued by coastal residents, but also by people who live in Central Texas, on the High Plains, in the Trans-Pecos Region, and in other upland areas. Noncoastal residents also have a stake in the future of coastal waters, not only because the coastal waters are publicly owned, but also because their uses benefit the state and the nation.

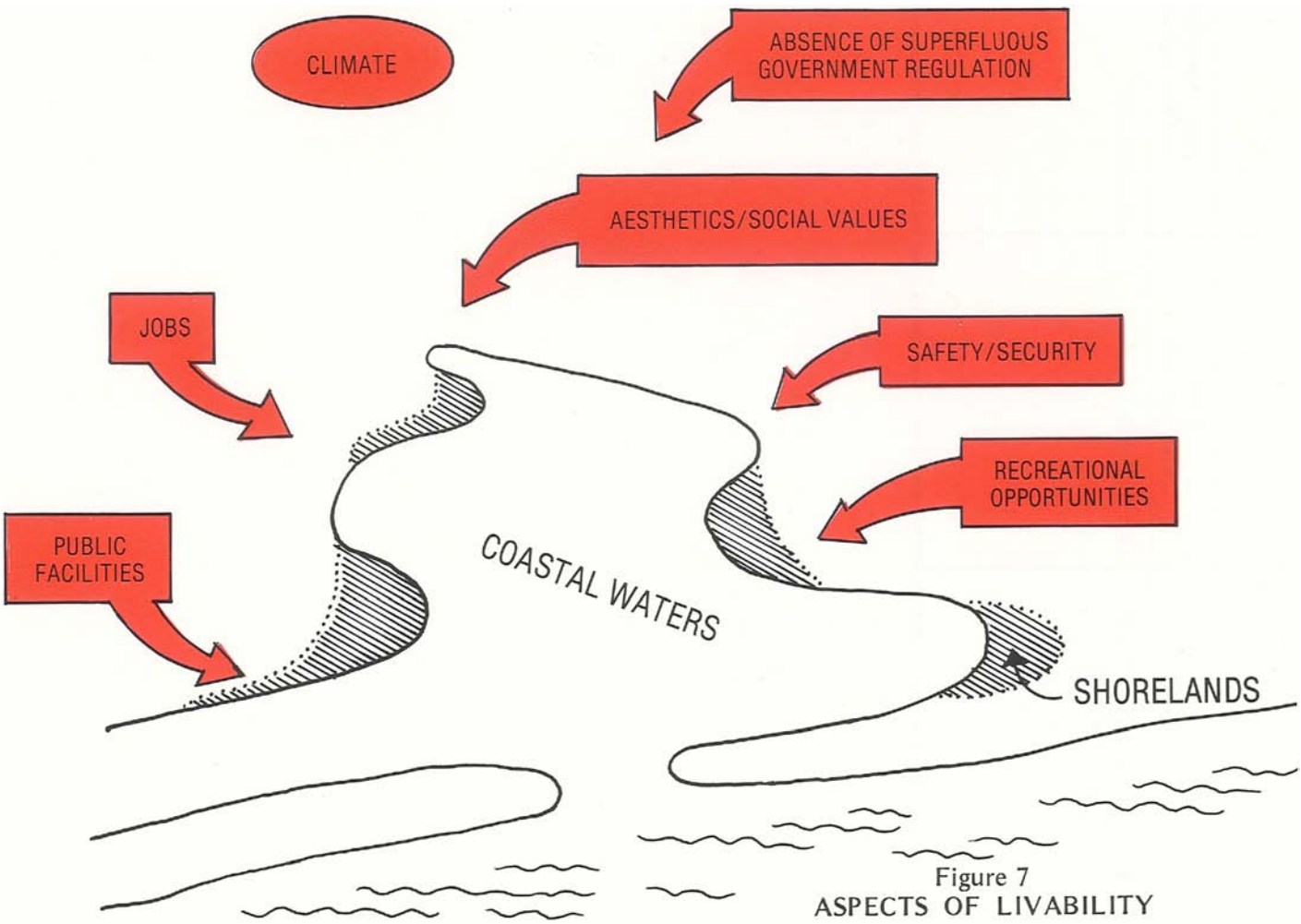


Figure 7
ASPECTS OF LIVABILITY

Besides natural resources, some other components are the availability of jobs, public safety, public facilities, and freedom from unnecessary governmental restrictions on the use of or access to public resources. People demand a mixture of elements for a high quality of life, but they assign different priorities to these elements. When public preferences are translated into a *political* will, the present dollar value of any one use of coastal waters should not by itself determine ultimate resource allocation. Because coastal waters belong to all Texans—not just to the highest dollar bidder, and not only to the people who live next to the Gulf and bay shorelines—decisions made on a local level that might preclude uses of regional benefit should also take into account the demands by the broader public for livability.

Just as the various economic sectors compete for resources, some of the components of livability conflict with one another. For example, jobs often depend on intensive economic activities that conflict with aesthetic or other social values. Freedom from governmental control may not be consistent with a desire for facilities funded with tax dollars or with the need for public access or public protection.

Jobs

Many jobs depend on the use of coastal natural resources. If job opportunities that are consistent with livability are to continue, *conservation* in the sense of *efficient use* must be practiced. There is a distinction between the concepts of conservation and preservation. C. K. Leith, a noted geologist, made a statement regarding enlightened conservation in 1935 which might be a touchstone for coastal management.

> Conservation is the effort to ensure to society the maximum present and future benefit from the use of natural resources. It involves the inventory and evaluation of natural resources, calls for the maintenance of the renewable resources at a level commensurate with the needs of society, and requires the substitution, where the conservation of human energy permits, of renewable or inexhaustible resources for those which are nonrenewable, and of the more abundant nonrenewable resources for the less abundant ones. It not only seeks to eliminate waste of resources if use can be economically feasible, but also looks forward to improvements in techniques of production and use, and requires that there be prompt and proper adjustments to advances in technology. It thus appears that conservation involves the balancing of natural resources against human resources and the rights of the present generation against the rights of future generations. It necessitates, moreover, the harmonizing of the procedures and objectives of conservation with the conditions of the present or future economic order, and calls for a careful allocation of duties and powers among private and public agencies.

This concept has been explored at length with respect to mineral resources (Flawn, 1966).

Aesthetics and Social Values

"Social value" is a concept that varies with time as well as from group to group and among individuals. Nevertheless, there seem to be commonly held values among residents of the coast. People value abundant open space, a pleasant climate, and scenic areas. They see value in a diversity of land, water, and plant and animal life in natural areas that can sustain a variety of uses. There is a value in a resiliency that allows intensive uses in one place without marring the scenic or other aesthetic qualities in another.

These noneconomic benefits are not valued equally, however. For example, who is to decide what a pleasant climate or a scenic view is worth? Questions such as this show why assessing social values is one of the most difficult problems in resource allocation and management. Both natural resources and economic activities can be quantified to some extent, but personal preferences cannot. These preferences often mean much more in a political context, however, than data on resources or economics.

Recreational Opportunities and Public Facilities

Recreational opportunities are afforded by a combination of natural attractions—beaches, dunes, fish, and wildlife—as well as by transportation systems and other facilities, which are usually paid for with tax dollars. Conflicts may arise because different kinds of recreation impose different demands. Some are solitary reflective activities, while others are intensive and sometimes destructive uses of coastal resources. Government has authority over much outdoor recreation; it can and must regulate certain uses. It provides access to and sometimes license for certain activities. Thus, it has established bag limits for waterfowl, restrictions on uses that destroy dunes, and provisions to promote public safety. These are all part of government's concern for the public interest.

Absence of Superfluous Governmental Regulation

Protection of public interests and maintenance of an attractive coast amid competing demands require a judicious balance between effective regulation and avoidance of undue governmental intervention into private matters.

Although anyone has the right, within bounds, to use public waters and facilities, the private property owner retains rights over his holdings. This is basic to the American concept of property, and it is an underlying premise of much public opinion regarding government. Governmental control should stop at the boundary of private landholdings. There are exceptions, of course: the power of eminent domain and laws constraining some activities in the interest of the public good. Nonetheless, superfluous governmental activities should be avoided. This message comes strongly from the people.

Conflicts between private rights and the public interest reflect personal preference questions. Which governmental activities are necessary to protect the public interest and which are not? One person may consider a governmental activity to be an abridgement of his rights, while his neighbor may consider the action a necessary protection of his own property rights. There are no simple solutions to such conflicts, but the courts have consistently protected private property rights and restricted them only in those cases in which one person's activities adversely affect others or nearby properties. This reflects a long-established American preference.

The same consideration should be given to the submerged lands owned by the state as is given to private lands, for these state lands and other public resources are not simply "up for grabs," but are dedicated by statute to specific purposes. The state's efforts to manage its own holdings according to these statutory mandates are not superfluous governmental actions any more than is the private property owner's management of his own holdings.

Safety and Security

A final component of livability is the feeling that one's life and personal property are secure. The state's criminal laws and police help provide this. Another aspect of security, however, is related to natural forces. These can be extreme in the coastal region, making safety a special concern there.

Hurricanes strike the Texas coast approximately every one and one-half years, often causing death and destruction through surging waters, wind damage, and subsequent flooding from excessive rainfall on the uplands. Other natural processes—recurrent stream flooding, shoreline erosion, subsidence, faulting, and ground failure—may also threaten lives and property. When these processes occur away from state lands, state government has a limited role since it attempts to keep its regulation of private lands at a minimum. The risks of climatic hazards along the coast must be assumed along with the benefits of living near coastal waters.

SUMMARY

Public and private concerns in the coastal region center partly on the coastal waters and shorelands and partly on the coastal uplands. Most public concerns focus on coastal waters and adjacent shorelands because of public ownership or regulation of many resources in and near coastal waters. Most of the uplands are privately owned, but there is a "crossing-over" of concern and of ownership. Some economic and private interests are concerned with possible and allowable uses of the public waters, while government is involved on selected uplands through its regulatory authority and other concerns.

There are three main bases for public concern in and around coastal waters. They are the economic activities generated by the use of coastal waters, the natural resources within and beneath coastal waters, and the livability of the coastal region. The components of these bases for concern interact—economic activities use natural resources, and natural resources provide the "raw materials" for a livable environment. Economic activi-

ties also produce jobs and dollar flows that increase livability and provide tax revenues that may be used for resource conservation projects or public works. Livability is determined by intangible values of resources, both natural and social. The coastal region can continue to be a livable place as long as economic and natural resources are used to promote human well-being.

CHAPTER II
CURRENT MANAGEMENT AUTHORITY

OVERVIEW

Although most management decisions affecting the coastal area are made by private interests operating in a market economy, they are made within the framework of local, state, and federal regulation. The role of state government has three basic facets:

1. The state owns and manages coastal public resources.
2. State government currently exercises extensive regulatory authority over many privately owned coastal resources and exercises further regulatory authority in the interest of public safety.
3. The state is a major investor in a variety of coastal facilities.

Because the Coastal Management Program has observed considerable interest among the public in the state's role in managing coastal resources, and because both the state and federal governments want the state to play a proper and effective role in coastal matters of greater than local concern, this chapter examines the role of state government in coastal management.

The Market System and the Role of Government

The private sector—from the individual citizen who shops in the grocery store to giant, multinational corporations—makes most of the decisions that affect coastal resource allocation. Such decisions as what use will be made of a particular tract of land, what product a plant will manufacture, or what crops will be planted are made by private decision-makers in response to market forces.

When public problems arise from private decisions concerning the use of coastal resources, it becomes necessary for government to intervene in the market system. For example, water pollution that results from a decision made in the private sector is an "externality," a problem which is not adequately resolved by private enterprise alone. Only a small portion of all coastal decisions, however, cause such problems.

Government also provides public works and services—roads, schools, and police and fire protection—which the private sector cannot economically furnish to all segments of the public. Finally, state government acts directly in the marketplace through leases, sales, and other market allocations of publicly owned resources.

Federal Government

Federal agencies exercise a great deal of authority over the resources of the Texas coast. The primary foundation of direct federal involvement in coastal management is the Commerce Clause of the United States Constitution, which reserves to the federal government the control over all interstate and international commerce. The Commerce Clause is the principal basis

for U.S. Army Corps of Engineers control over activities in, on, or under navigable waters.

Federal authority also derives from the extensive air- and water-quality legislation enacted in the last decade. A state's air and water pollution control activities must conform to the national standards. Much of the federal influence over state and local governments, however, stems from financial control and is not a direct federal override of state authority. For example, if a state fails to conform to the Environmental Protection Agency's (EPA) administration guidelines, both that state and its local governments will lose hundreds of millions of dollars in construction assistance for such projects as sewage treatment works.

Other federal agencies regulating Texas coastal land and water resources include the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the Bureau of Land Management, the Department of Transportation, the Department of Agriculture, and the Department of Defense. In addition to regulatory responsibilities, many federal agencies have concerns in areas which they do not directly regulate, such as economically depressed areas, sensitive wildlife habitats, and natural hazards.

The resources of the Texas coast—natural, social, and economic—are important not only to Texans but also to the rest of the nation. Texas ports, for example, serve both the state and the nation. The national interest in Texas coastal resources usually differs only in degree from the interest of Texans. Sometimes the national interest in the siting of facilities on the Texas coast may be great enough to override any state or local opposition. While conflicts are few, Texas must be willing to recognize the national interest if no compromise is possible. In most cases, it should be possible to serve the national interest in a way that satisfies state or local objections without interfering with Texas' obligation to manage its coastal resources.

Plate 2 shows those areas of the Texas coast already wholly or partially owned by the federal government and those geographic areas in which federal agencies have some special concern or responsibility. These areas of national interest represent demands made on the Texas coast by the nation, expressed through federal agencies.

Local Government

Although federal and state governments have extensive coastal regulatory authority, most governmental decisions regarding the coast are made by local governments. Cities, counties, navigation districts, river authorities, school districts, and other political subdivisions make almost all of the governmental decisions in the coastal region because most coastal issues requiring governmental action are not matters of greater than local concern. There is no need to invoke any more removed or remote governmental entity. Some local government

decisions, however, are shaped partly by the guidelines and regulations issued by state and federal agencies. The effectiveness of this influence stems from the dependence of local governments on state and federal funds. Within the limits of the regulations governing the use of these funds, local governments will continue to make most public decisions affecting the coast.

STATE COASTAL MANAGEMENT

Background

Almost 100 years of management efforts have demonstrated the state's concern for ensuring Texans continual benefits from coastal waters. These efforts have included the passage of legislation to protect and develop coastal resources in the public's best interest.

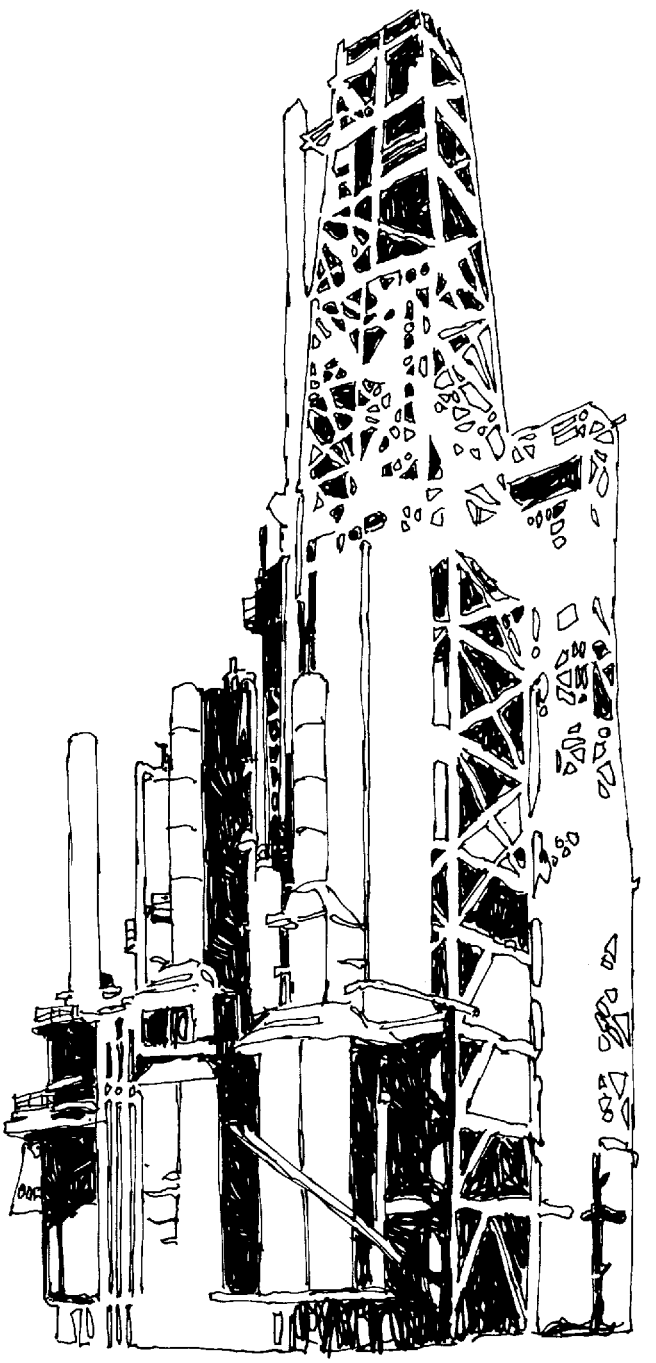
Historically, the legislature has taken a problem-specific approach to coastal management, passing laws to resolve individual problems as they have arisen. The legislature continues to take this pragmatic approach to resource management, not only along the coast, but throughout the state. Few successful efforts have been made to approach resource management on a comprehensive basis.

The state constitution and laws have created an executive branch primarily composed of a few statewide elected officials and many appointive citizen commissions or boards. The constitution also provides for a strong legislative branch of government. This system has firm public support and many advantages:

- —The executive branch agencies do not develop excessive power, because Texas does not have appointed administrator-bureaucrats. Instead, it has statewide elected leaders or citizen commissions or boards.
- —Citizen participation in governmental decision-making is increased through the public board members and commissioners.
- —The legislature influences the executive branch by its domination of the budget process.
- —Agencies pursuing conflicting statutory missions under the supervision of independent boards and commissions tend to give significant public issues more vigorous advocacy and public airing than a "cabinet-style" executive branch, in which dissenting or inconvenient views can be easily suppressed by threats of dismissal.

This system also has disadvantages:

- —A weak executive frequently means a lack of unified direction for state government.
- —Agencies function rather independently, which often results in conflicting policies and expensive duplication of effort.
- —Agency autonomy and the lack of effective interagency coordination make it difficult for a person from the



private sector to find his way through the maze of state government. Agencies may give different answers to the same question, and there is usually no rapid means to resolve such conflicts.

Management of Texas' coastal resources is fragmented among many state agencies. Instead of being consolidated in a single state department of natural resources or a state environmental protection agency, resource management functions are shared by more than a dozen independent agencies. Nonetheless, the state now has the authority required to manage its coastal resources effectively.

Texas has many statutes concerning air resources, water quality, solid-waste disposal, submerged lands, fish and wildlife, natural hazards, recreation, transportation, minerals, energy, beaches, and many others. These laws provide for the protection and regulation of the development of coastal resources in the public interest.

Texas' "problem-oriented" approach is also apparent in legislatively ordered investigations and studies. The legislature has authorized several specific investigations by special committees and agencies and has funded a number of research efforts on the campuses of state colleges and universities. Many pieces of key legislation affecting the coast can be traced directly to recommendations resulting from these studies. For example:

1. Studies by several interim beach committees and the decision of the celebrated *Luttes* case preceded the landmark 1959 Texas Open Beaches Act.
2. The Water Agency Reorganization Act of 1965 directed the Texas Water Development Board to develop a state water plan. The board was directed specifically to consider freshwater allocations to bays and estuaries. This and other actions resulted in the enactment of S.B. 137 (1975), which makes it a state policy to provide water for the bays, directs the Water Rights Commission to consider impacts on bays when reviewing permits, and calls for specific freshwater inflow requirements to be set by 1979.
3. Senate Concurrent Resolution 38 in 1969 directed the Interagency Council on Natural Resources and the Environment (ICNRE) to conduct a comprehensive study of coastal resources and make recommendations for improving management. The council's recommendations led to the passage of S.B. 644, the Coastal Public Lands Management Act of 1973; S.B. 274, which authorizes the School Land Board to lease land to navigation districts; several study resolutions, all passed in 1973; and a state oil spill bill, enacted in 1975.
4. The House Interim Committee on Marine Resources (1971-1973) recommended the creation of a state agency to examine the "supertanker" issue. In 1972, a special session of the legislature created the Texas Offshore Terminal Commission.

Existing Coastal Policy

The legislation described above includes some of the strongest policy statements made by the legislature about management of the state's coastal resources. The Coastal Public Lands Management Act of 1973 is especially strong in recognizing the role of state government in the management of the public resources of the coast. Among the policies declared in the act are:

a. The natural resources of the surface estate* in coastal public lands shall be preserved. Such resources shall be construed to include the natural aesthetic values of those areas and the value of such areas in their natural state for the protection and nurture of all types of marine life and wildlife.
b. Uses which the public at large may enjoy and in which they may participate shall take priority over those uses which are limited to fewer individuals.
c. The public interest in navigation in the intracoastal waters shall be protected.
d. Unauthorized use of public land shall be prevented.
e. Utilization and development of the surface estate in such lands shall not be allowed unless the public interest as expressed by this Act is not significantly impaired thereby.

The act also prohibits the sale of coastal public lands except in very limited cases and protects private property rights in nonpublic lands.

These policies express the legislature's concern for the proper development of coastal resources. It is noteworthy that these are existing state policies, but that the legislature has not enacted a process to assure an ongoing integration of the state's many coastal management policies and efforts.

Coastal Policy and Funding

The state legislature turns its decisions into policies through appropriations. This connection between decision-making and policy implementation is not always obvious, but the budget is the state's real operating plan.

Only after the legislature has provided funds can state boards and commissions develop programs to implement legislative policies. Boards and commissions also make policy by interpreting legislative decisions and by obtaining legislative approval of budgets. To understand how coastal decisions are made and how policies are funded and implemented in Texas, it is necessary to understand the functions of the legislature and the boards and commissions.

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*The term "surface estate" used in the act is a legal term used to distinguish the oil, gas, and other mineral rights from the ownership of the surface and waters above the surface of the state's coastal lands. Thus, the lands could continue to be used for mineral development as has been permitted in the past under regulation by the General Land Office and School Land Board.

Legislative Role

The functions of the legislature in coastal management are:
—to pass laws to provide incentives and regulations;
—to establish agencies to administer these laws;
—to appropriate funds to agencies to enable them to carry out legislative and agency policies;
—to sponsor studies of coastal problems and policies;
—to evaluate the effectiveness of existing agency programs and policies; and
—to implement new policies.

Board and Commission Form of Government

The State of Texas has a "commission" or "board" form of government. Most state agencies involved in the allocation or regulation of coastal resources are supervised by part-time citizens' boards whose size and composition vary greatly. These boards are appointed by the governor or selected in other ways. The Railroad Commission of Texas, the General Land Office, the Comptroller's Office of Public Accounts, the Attorney General's Office, and the Agriculture Department are headed by statewide elected officials. Other boards have members appointed by various officials; for example, the School Land Board is chaired by the land commissioner and has two citizen members, one appointed by the governor and one by the attorney general.

The staff of each agency is directly responsible only to its own board, commission, or elected official, who in turn must answer to the governor, because he appoints and reappoints members, and to the legislature, because it provides funding, directives, and powers. These boards usually appoint a full-time executive director who is responsible for the day-to-day administration of the agency and the hiring of other staff members. Figure 8 shows the typical organization of the state agencies and depicts lines of responsibility.

Two exceptions are the Texas Water Quality Board and the Texas Forest Service. The Texas Water Quality Board is composed of the executive directors of the Parks and Wildlife Department, the Texas Department of Health Resources, and the Texas Water Development Board; the chairman of the Railroad Commission of Texas; and three gubernatorially appointed public members. Thus, the executive director of the Texas Water Quality Board answers in part to the executive directors of other state agencies, who in turn answer to their respective boards and commissions. The board of the Texas Forest Service is appointed by the board of directors of the Texas A&M University System.

The Extent of Current Authority

The regulatory authority of the state agencies covers all activities of state concern that might be undertaken in the state's coastal area. Figure 9 illustrates the division of the executive branch into many agencies that have authority to manage various coastal resources. Figure 10 lists the agencies that have

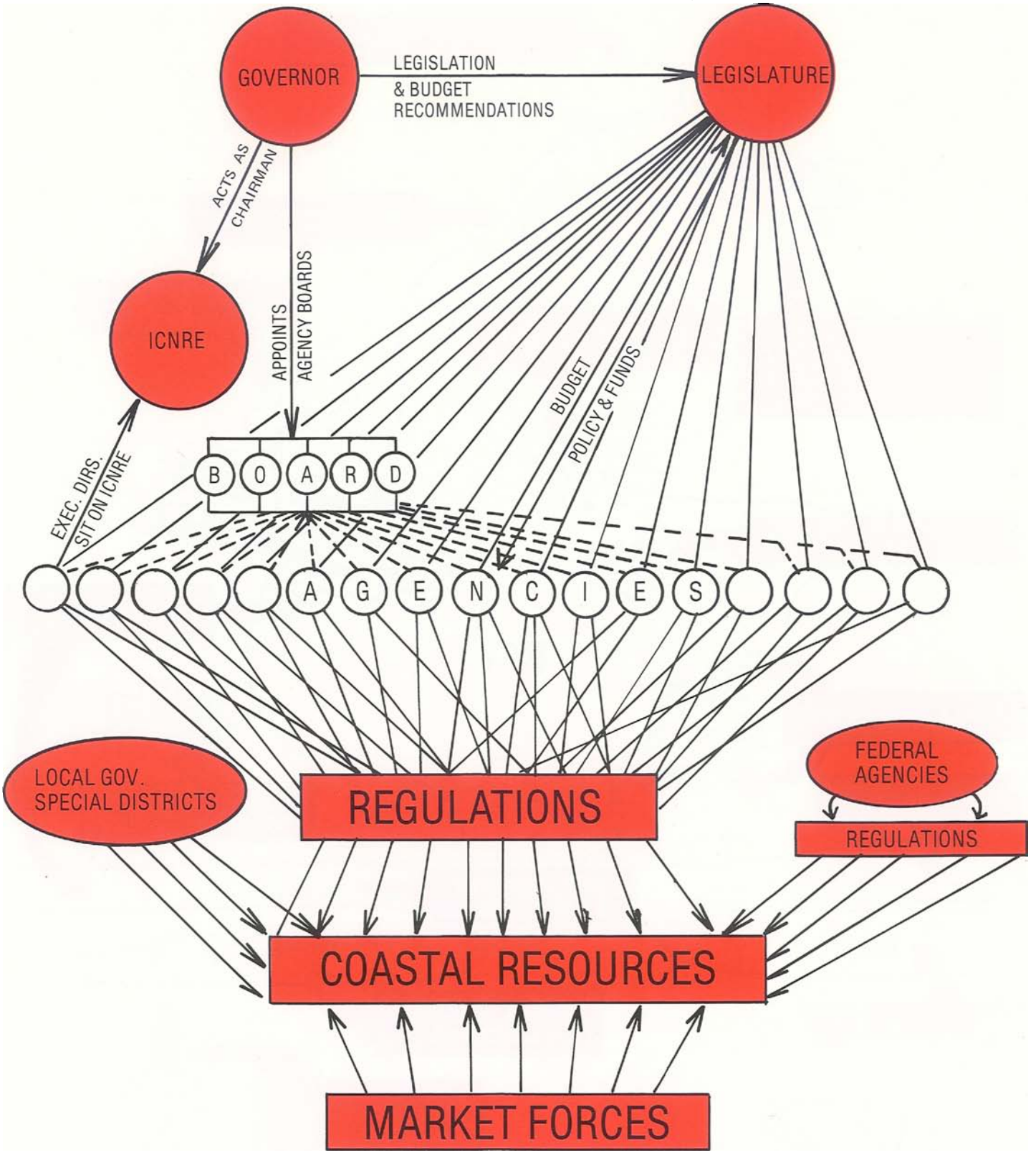
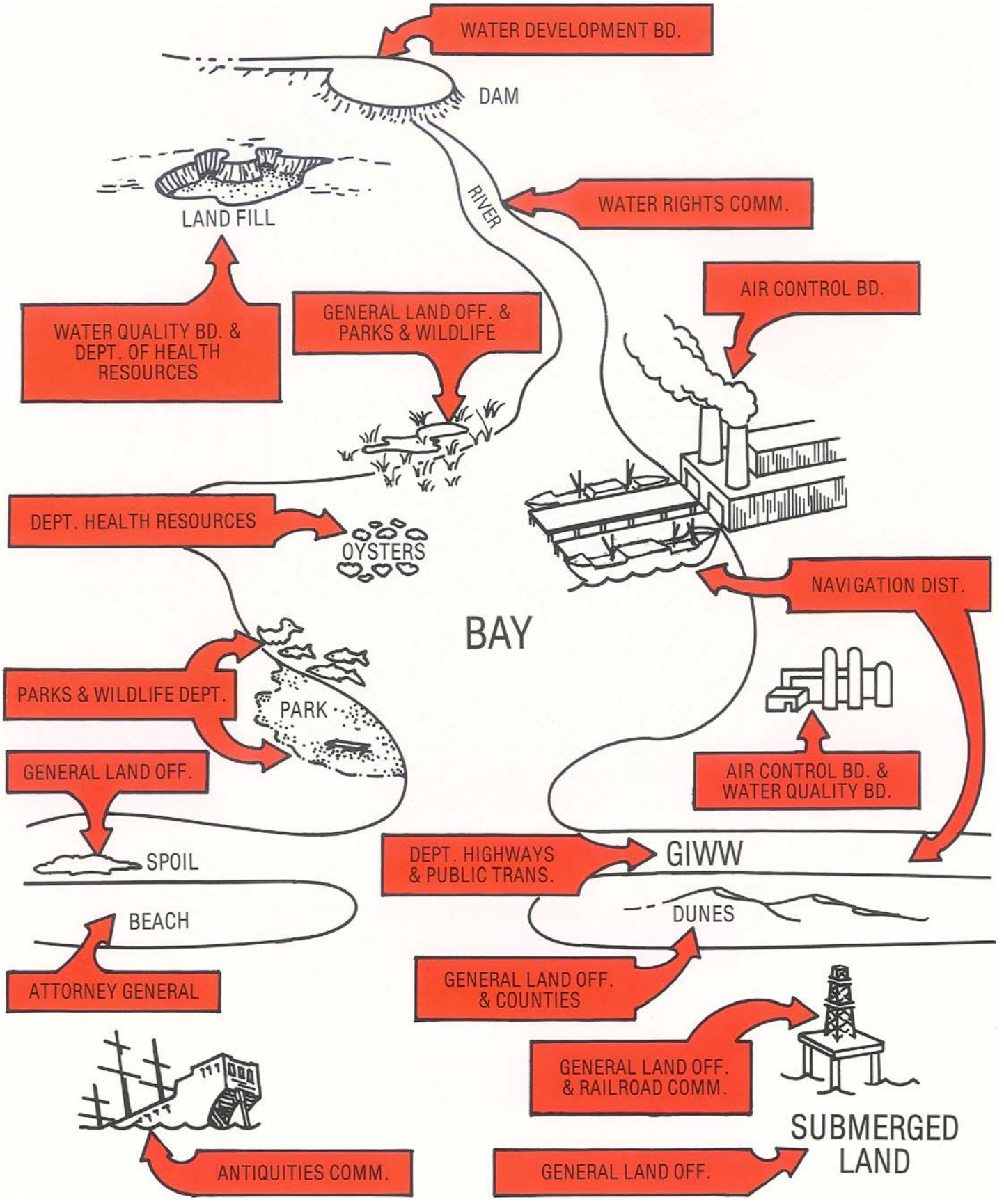


Figure 8
ORGANIZATION OF STATE COASTAL MANAGEMENT

Figure 9

EXAMPLES OF COASTAL AREAS
REGULATED BY STATE AGENCIES



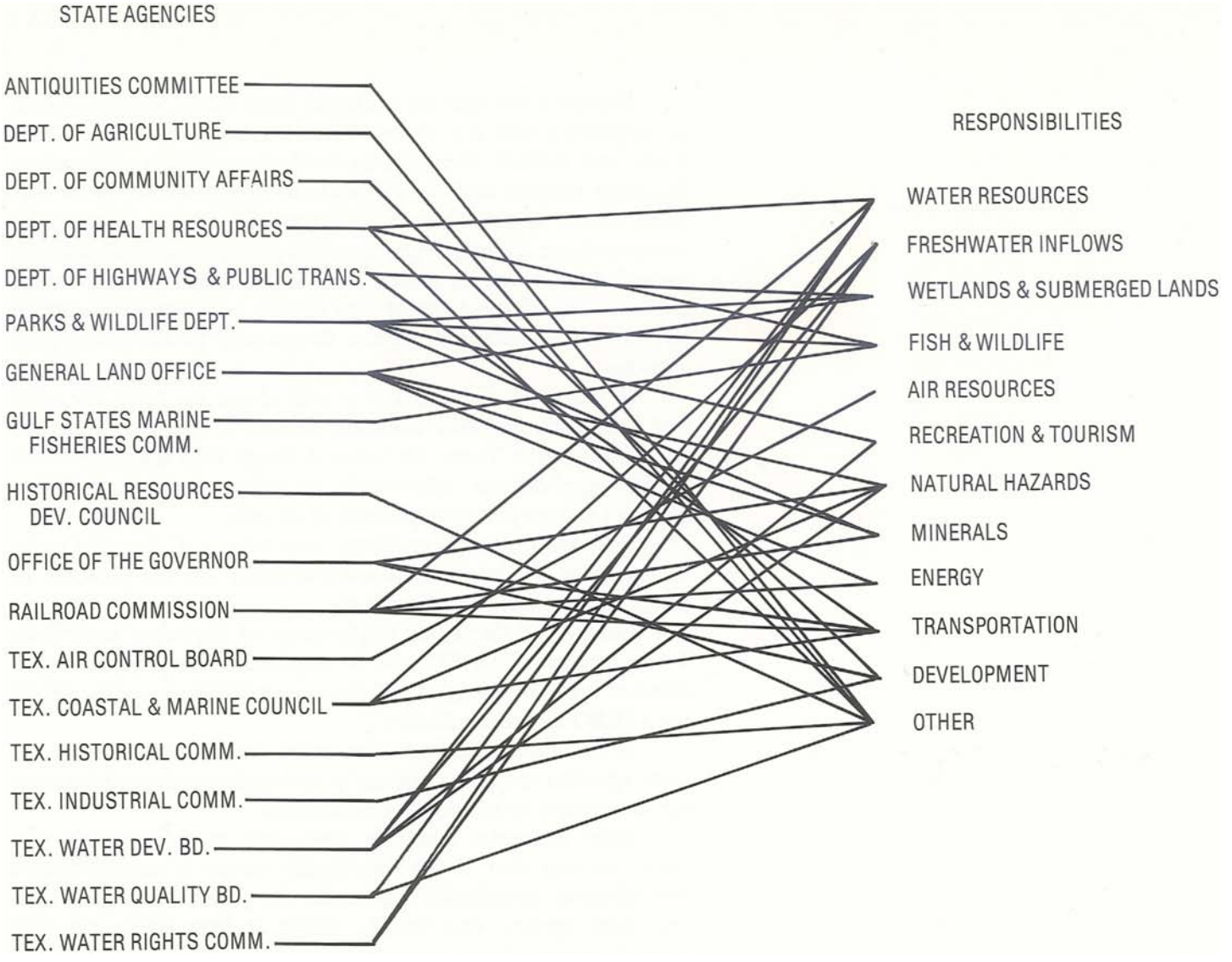


Figure 10
RESPONSIBILITIES OF VARIOUS STATE AGENCIES

primary and secondary responsibilities over 19 typical coastal activities. These figures show the extent and complexity of current coastal management. Every aspect of even a "minor" coastal project falls under the authority of some state agency.

A discussion of the permits required from various state agencies to perform a maintenance dredging project illustrates the extent of current state involvement in coastal management.

Example of Permit Requirements

If submerged lands are to be used for dredged material disposal, a permit is required from the School Land Board. Three questions will be considered:

1. whether or not such action may adversely affect other submerged lands,
2. whether it will interfere with mineral production, and
3. whether an environmental impact report is needed.

If, as is usually the case, a federal environmental impact statement is required, the state environmental impact report will be waived.

Permits must also be obtained from the U.S. Army Corps of Engineers and the Texas Water Quality Board. The Texas Parks and Wildlife Department must comment on applications for these permits and the applications submitted to the School Land Board. A permit from the Parks and Wildlife Department is required for dredging operations involving removal of publicly owned sand, marl, or gravel. The Texas Water Quality Board and the School Land Board also will be asked to comment on the permit applications to the Corps and to the other state agencies.

If the spoil disposal site is well above sea level, the spoil will eventually dry out and may become a nuisance when the wind blows. The Texas Air Control Board thus may review the permit applications submitted to other state and federal agencies and may require permits of its own.

The Antiquities Committee may object if the area to be dredged has not been examined previously for the presence of historical or prehistorical artifacts.

Consent of the Texas Department of Highways and Public Transportation (TDHPT) will be required if the proposed spoil disposal area is near the Gulf Intracoastal Waterway, for which the TDHPT has responsibility.

In addition to the agencies listed, several other federal and state agencies may be involved in reviewing permit applications for the project or issuing federal permits.

More examples could be presented to demonstrate that every activity that could conceivably occur in coastal waters and adjacent shorelands falls under the jurisdiction of at least one state agency, and usually under at least the companion federal agency. State government is currently involved in the management of all coastal resources with the exception of some wetlands, all of which are regulated by the U.S. Army Corps of Engineers.

Informal Management Priorities

As the agencies develop programs to implement their statutory responsibilities, they also develop concerns in particular geographical areas of the coast (plates, 3, 4, and 5). These areas have special significance for the board or staff because of agency expertise in the area or some special importance the area has in the agency's regulatory, developmental, or research efforts. Unfortunately, these areas have been designated only informally and the public is not generally aware of them. An agency may deny or oppose a permit because of a particular concern it has about an area without giving the applicant advance notice about this concern. These geographic "areas of particular concern" in the coastal region are discussed in more detail in the next two chapters. They are cited here as an example of the unwritten or unpublicized interests that often influence agency management decisions.

Coordination of Agency Activities

The principal entity for the coordination of state agency coastal activities is the ICNRE, composed of the administrative heads of the state agencies responsible for management of natural resources. The council is chaired by a representative of the governor. The ICNRE was established by an executive order of the governor under a 1967 statute that created the Governor's Division of Planning Coordination (now the Governor's Budget and Planning Office) and authorized the governor to create interagency councils where appropriate. The effectiveness of the ICNRE may be debated, but the following general statements can be made about council operations:

- —The effectiveness of the council is determined largely by the strength and persistence of the leadership exerted by the governor or his designated chairman.
- —The council's principal role has been to improve communication among agencies. It has no authority to require cooperation and coordination.
- —The council meetings are usually spent in broad discussion and condemnation of federal intrusions into state affairs, establishing committees to study issues, and in scheduling subsequent meetings of the council or its subcommittees.
- —Member agencies generally pay little attention to the council, considering it only a discussion forum.*
- —Neither the executive directors nor their alternates (who attend more frequently) have authority to make policy. Thus, there is rarely, if ever, an attempt by the council to confront and resolve policy or program differences between or among agencies.

The A-95 Review Process

When projects involve grants of federal funds to state and/or local governments, the principal coordinating process used is the "A-95" review, named after the federal Office of Management and Budget Circular No. A-95, which outlines the coordination procedures. The A-95 process is used to review state and local requests for various types of federal programs. It involves a system of regional and state clearinghouses administered by the councils of governments and the Governor's Budget and Planning Office (GBPO) (fig. 11). Under the A-95 procedures, a local request for federal assistance is first sent to the local regional clearinghouse, where it may be commented upon by other local governments in the same region. It is then forwarded to the state clearinghouse, where it is distributed to the principally affected state agencies for comment.

The application is then sent to the federal regional clearinghouse and reviewed by the regional offices of the appropriate

*An exception involving the ICNRE is worth noting. When faced with the possibility of legislative action to set up a state environmental impact process, the ICNRE members adopted and implemented a state procedure to apply to state projects.

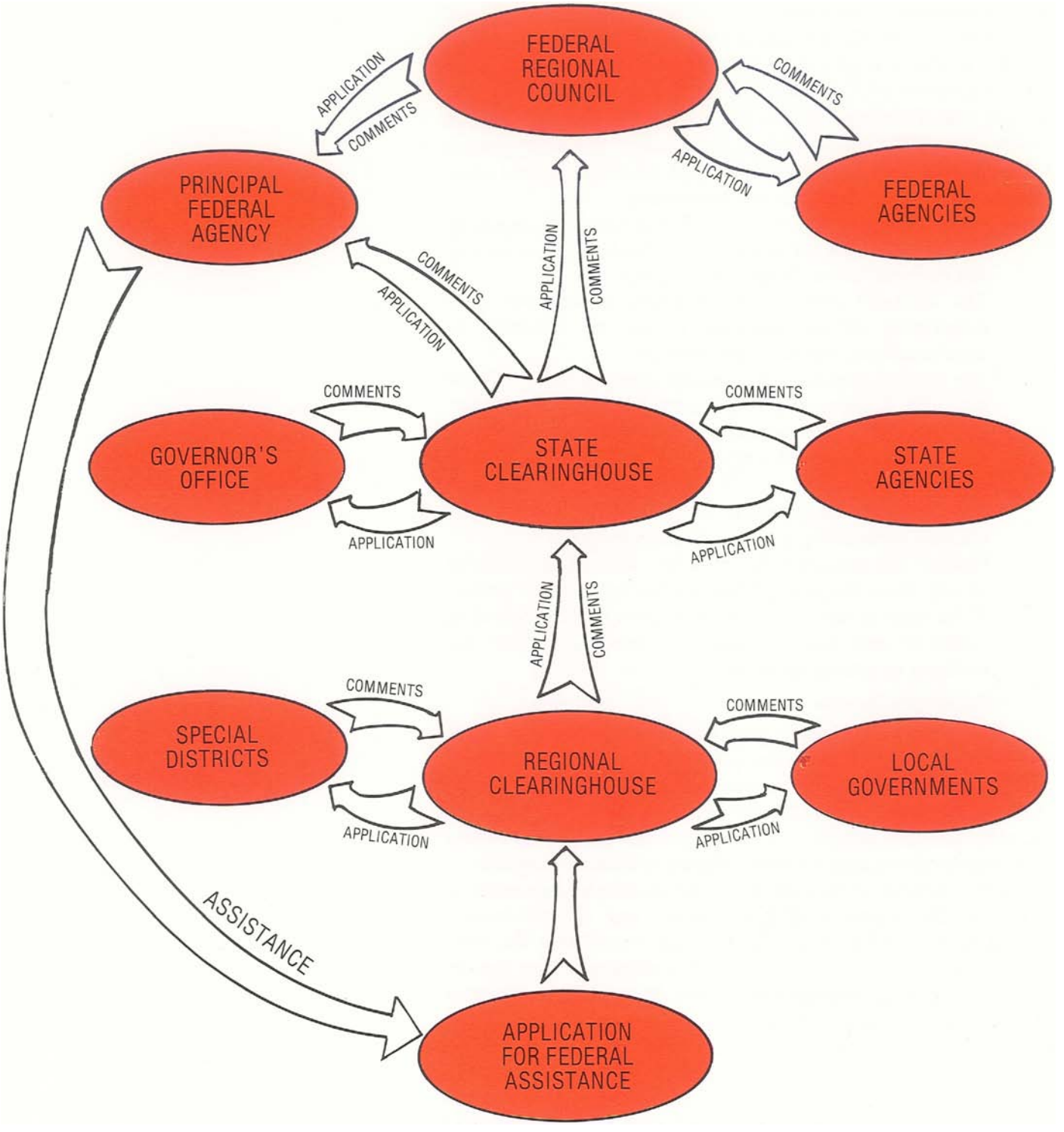


Figure 11
A SUMMARY OF THE A-95 REVIEW PROCESS

federal agencies before being forwarded to the federal agency responsible for final action. This procedure can be time-consuming, confusing, and costly.

The federal clearinghouse is administered through the federal regional councils (FRCs). Each FRC consists of the designated representatives of the principal federal agencies in a particular multistate region. However, the geographic regions of the member agencies in an FRC often differ.

Environmental Impact Statements

Perhaps the best known interagency coordination device is the environmental impact statement (EIS). Any federal action that might have a significant environmental impact requires an EIS. A draft EIS prepared by a federal agency is reviewed at local, state, and federal levels. At the local and state levels, the statements generally are distributed through the local and state clearinghouses, as are A-95 reviews. The Council on Environmental Quality coordinates EIS reviews among federal agencies.

Informal Coordination

Besides the formal coordination mechanism, many informal procedures exist among agencies. Agencies at the local, state, and federal levels that have similar responsibilities frequently establish informal relationships as personnel who work together trade information. These informal procedures often go further than the formal procedures in providing the necessary coordination, but they do not always exist where needed and depend almost totally upon personal contacts among personnel, who can and do change. These informal channels generally are inadequate for policy coordination. The staff members at this level do not formulate agency policy. Thus, coordination is usually confined to technical matters, and the major interagency policy conflicts remain unresolved.

Public Involvement

Public involvement is one of the least consistent elements in the present coastal management process. Whether this involvement is direct (through public hearings) or indirect (through elected leaders) it is frequently only a formality.

The public is obviously involved in coastal management indirectly through the elected legislators and governor who provide direction to the agencies, but this indirect involvement seldom allows the expression of public opinion in specific cases.

State agencies establish their own rules for public participation under guidelines established by law. These rules vary widely. For example, the Texas Water Quality Board (TWQB) allows anyone to speak at permit hearings. The only requirements are that speakers must address only the topic under discussion and speak within a specified time limit. In contrast, the Texas Air Control Board (TACB) requires speakers to file written comments in advance of the hearing and attend a prehearing conference. These requirements take several visits to the agency, time, money, and usually legal assistance. Thus, public

involvement in state agency decisions is inconsistent, and it is often ineffective.

SUMMARY

Coastal management has been a public concern in Texas for a century. Most management decisions are and will continue to be made by individuals in the market system. The remainder of the coastal management decisions will be made by government; and of these, most will be made by local governments. The foundation of the state's present activities in coastal management is its three-part role as owner, investor, and regulator. The state has the authority to regulate all coastal resources with the exception of some wetlands. This authority has been given to various agencies by the legislature in response to particular problems. It is the policies of these state agencies that determine which uses of coastal resources are permissible and which uses are given priority, but the lack of policy-level coordination among agencies often produces inconsistent decisions on these questions.

Despite the broad authority of state agencies, problems of coordination frustrate state efforts, denying the people the benefits they seek from coastal waters.

CHAPTER III
DOCUMENTATION OF PROBLEMS

OVERVIEW

Many governmental agencies have regulatory mandates in the coastal region. The management policies of these agencies cover many of the issues that should be addressed by a comprehensive management program, but many problems are not dealt with adequately by the existing system.

Some of these problems exist exclusively on the uplands, for example, the competition for space between agricultural and housing interests. The loss of agricultural lands is an issue of widespread concern; it is not, however, a valid concern for a coastal management program. Whether this problem should be addressed through new tax policies favorable to agricultural productivity, new regulations at the local level, or some other means is an issue better reserved for another inquiry. Because agriculture and other upland activities do not have direct and significant impacts on coastal waters, they are outside the realm of coastal management.

Activities that do have direct and significant impacts on coastal waters and problems that are distinctly coastal are coastal management concerns. A number of coastal problems, unsolved by present policy, have been identified and are documented in this chapter. They are related to one or more of the three stated bases for concern: economic activities dependent on coastal waters, the resource base of coastal waters, and coastal livability. Some of the problems described are not unique to the coastal region, but are institutional issues that affect the proper allocation of resources or the safety and security of people and property in the face of natural hazards.

The distinctly coastal problems discussed here are related to natural hazards and the management of bays and estuaries. Coastal natural hazards include hurricanes, subsidence, and shoreline erosion. Bay and estuarine management problems are associated with the documentation of marsh values, the determination of freshwater inflow needs, and dredged material placement. The institutional problems discussed include inadequate information dissemination and data management, inefficiencies in the permitting process, and problems associated with the use of the budget as a tool in policy planning. The last problem discussed in this chapter is partly coastal and partly institutional. This is the boundary problem, or the task of determining the proper geographic and institutional limits for a coastal management program.

COASTAL PROBLEMS

Natural Hazards

The Texas coast is the site of intensive natural processes. One of these processes is hurricanes, with accompanying destructive winds, tornadoes, storm surge, catastrophic erosion of shorelines, and subsequent heavy rainfall flooding. Other processes include river flood runoff that may inundate coastal lowlands, sedimentation that occurs near river mouths or tidal

passes, normal shoreline erosion and accretion, compaction and subsidence of soft sediments, faulting, and ground failure.

Most coastal natural processes were active long before man occupied the Texas coast. Natural systems have adapted to these disturbances, but when natural processes adversely affect man or his works, they become hazards and thus a focal point of public concern. This section attempts to document known or potential human problems associated with three hazardous processes: hurricanes, shoreline erosion, and ground-surface subsidence.

Hurricanes are recurrent, violent storms having far-reaching effects. It is impossible to predict exactly where or when a hurricane will occur. Other processes, such as shoreline erosion and subsidence, are more subtle, occurring as incremental and sometimes almost imperceptible changes in land and water. Both their long-term rates and the localities they will affect can be predicted to some extent.

Both types of processes—one unpredictable, catastrophic, and far-reaching, the other localized, incremental, and somewhat predictable—pose an institutional problem, in that the public should be informed about them. Man is affected by these processes when he either occupies a hazard-prone area or unwittingly upsets a delicate balance and sets a hazardous process in motion. Because the Texas coast is densely populated, at least in its upper reaches, there is a greater opportunity for otherwise inconsequential natural processes to harm human life and property.

Gathering adequate information about natural hazards is no easy task. The principal reason for this is that no one can delineate hazardous areas with precision, although scientific estimates are available. Another problem is that the full consequences of man's actions cannot be predicted with current technical knowledge about natural systems; only the probable nature and extent of their effects have been estimated.

These gaps in the understanding of coastal processes are widened by the difficulty of communicating the existing information to the users of coastal lands and waters. The state now has no central repository for data about these processes and only limited programs for educating the public about them. Public ignorance about natural processes increases the danger of hazards.

Hurricanes

Hurricanes strike the Texas coast on an average of about once every 1.5 years. Total damage since 1900 has exceeded $1.3 billion, and 114 lives have been lost during this period. The Galveston hurricane of 1900, one of the worst natural disasters in the nation's history, resulted in 6,000 deaths. Coastal residents may be even more vulnerable to such a catastrophe now than in 1900, because more people now occupy low-lying areas. Moreover, long-range prediction of storm generation and hurricane paths is not possible. Only after a hurricane has begun its

approach to shore is there any warning, and then inhabitants usually have only a few hours of preparation or evacuation time.

Hurricanes are highly variable in the kinds of effects they produce and in the extent of their damage. A general classification of hurricane types has been made (McGowen and others, 1970), based on the characteristics of three storms that have struck the Texas coast in recent years (table 2). The "*Beulah* type" is characterized by extremely high rainfall with only moderate-force winds and moderately high storm surge. The "*Carla* type" has high storm surge with lesser winds and lesser attendant rainfall. The "*Celia* type" has extremely destructive winds with more moderate storm surge and little rainfall. The amount of damage caused by a hurricane is determined by the hurricane type, the terrain it strikes, and the population density along the hurricane path.

Coastal lowlands, especially barrier islands and the upper parts of funnel-shaped bays, are perhaps the most susceptible to hurricane damage. However, any such area may be left untouched and more "secure" uplands damaged, depending on the specific path of the hurricane. Even though hurricanes are coastal hazards, their effects have been felt as far inland as Austin (*Carla,* 1961) and the Pecos River basin (*Alice,* 1954).

Conceivably, a "composite" storm could occur that would combine the most destructive attributes of each of the three hurricane types. The destruction caused by such a storm could

Table 2
CHARACTERISTICS OF BASIC TYPES OF HURRICANES STRIKING THE TEXAS COASTAL ZONE

Variables	Beulah Type	Carla Type	Celia Type
Wind	Moderate	Moderate	High
Storm-surge tides	Moderate	High	Low
Rainfall	High	Moderate	Low
Size of destructive core	Medium	Large	Small
Duration of effects	Extended	Intermediate	Brief
Character of affected coastline	Port Mansfield: poorly vegetated, low elevation, broad unrestricted bay	Port O'Connor: well vegetated, elevation 30 feet, funnel-like Lavaca Bay	Port Aransas: moderate vegetation, elevation to 30 feet, funnel-like Nueces Bay

*Adapted from McGowen and others (1970).

well exceed that of the Galveston disaster if it struck a densely populated area along the upper reaches of a funnel-shaped bay or along a highly developed barrier island. Even without this worst combination of conditions, however, the effects of hurricanes are far-reaching and highly destructive. Surge tides from *Carla* flooded 2 million acres with salt water, and *Beulah* flooded 1.4 million acres with rainwater. Although *Carla* came ashore near Port O'Connor, the storm surge flooded areas as far away as Baytown, 120 miles up the coast. *Beulah* came ashore at Brownsville and produced record floods as far north as the lower Nueces, San Antonio, and Guadalupe Rivers. *Celia* impacted the smallest area of the three but struck the highly developed Corpus Christi area, causing the greatest property damage, $453 million. Together, these storms resulted in 72 deaths.

Hurricanes not only create problems for the people whose lives and property are endangered but also for government, the larger public, who rightfully subsidizes disaster relief and who—more questionably—subsidizes certain private risks. The problems are as follows:

1. Hurricanes are largely beyond human control. A hurricane of moderate strength releases as much condensation heat energy in a day as the nuclear fusion energy of 116 100-megaton hydrogen bombs (Brown and others, 1974).
2. Hurricanes have many destructive characteristics, the most notable being storm tides that surge onto the uplands more than 20 feet above mean sea level, gusting winds up to nearly 200 miles per hour, and associated high levels of rainfall over a brief period of time.
3. These destructive forces may be heightened by the type of landform impacted. Low-lying areas may be completely inundated; barrier islands, especially those of low relief or with scanty dune protection, may be breached by numerous washover channels; and narrow, funnel-shaped bays increase the height of storm surge.
4. A hurricane's ultimate impact on man largely depends on the extent of human development in the area struck. Man may unwittingly increase damages to himself and to his neighbors in a number of ways. Dunes serve as natural "seawalls." Man may destroy this natural defense against storm surge through unwise construction practices or the removal of natural dune vegetation. Inadequately built structures may collapse in high winds, and pieces of destroyed buildings may batter and wreck other more stable structures. Unwise road placement may invite destruction by storm surge, as roads may provide ready-made channels through the dunes. Moreover, many roads are not elevated enough to remain above even the forerunner tides that precede a hurricane. This flooding, of course, impedes evacuation.

Shoreline Erosion

Most shorelines of the Texas bays and open Gulf areas change continually. These changes occur both rapidly and over very long periods of time. Shoreline equilibrium or accretion occurs in local areas, but the dominant trend along the Texas coast is erosion of shorelines (table 3). This trend has been well documented for Gulf shoreface areas (*see* Brown and others, 1974; Morton, 1974; Morton, 1975; and Morton and Pieper, 1975, a-b). The trend has been presented only qualitatively for bay margins (Brown and others, 1974).

Factors controlling erosion or accretion are largely beyond human control. These controlling factors include the offshore and beach sediment supply; dominant wind directions and the resulting angle at which major waves strike the shoreline; the distance over which waves are generated; and the recurrence, intensity, and location of hurricane impact. Except for the occurrence of extraordinary events such as hurricanes, the elements affecting erosion of Gulf and bay shorelines can generally be predicted even if they cannot be controlled. Nonetheless, man has occupied eroding areas, often without realizing that the hazard exists, and his attempts to control erosion are often futile or only temporarily effective. Most mitigation attempts are small-scale efforts aimed at a long-term, large-scale problem. Frequently, the effect of these efforts is short-term erosion control in one area with increased erosion in neighboring areas.

The trend toward erosion of Texas beaches occurs basically because the sand supply is insufficient to maintain an equilibrium along the 367 miles of Gulf shoreline. The sand deficit on the beaches is a result of the sediment content of offshore areas, where there is more mud (fine-grained sediment)

Table 3
LONG-TERM EROSION RATES ALONG THE TEXAS COAST

	Miles	Percent
A. Gulf Shoreline		
Erosion greater than 10 feet per year	47	13
Erosion of 5-10 feet per year	50	14
Erosion of less than 5 feet per year	104	28
Accretion or Equilibrium	166	45
B. Bay Shorelines		
(Note: Total bay/lagoon shorelines equal 1,100 miles)		
Erosion of variable rates	408	37

Adapted from Brown and others (1974).

than sand (coarse-grained material). Beaches are nourished when waves carry sand ashore. Mud, however, remains suspended in the water when there is wave action. When there is a higher concentration of mud than sand, little material is deposited on the beach.

Furthermore, little sandy sediment is presently being supplied by rivers entering the Gulf. Only three Texas rivers—the Brazos, the Colorado, and the Rio Grande—empty directly into the Gulf of Mexico, and all three are impounded so that a significant part of their sediment loads is trapped. The Mississippi River no longer supplies sand for the Texas coastline because it now empties into the Gulf on the east side of its delta.

A "sediment budget" analogy may be drawn. Texas shoreline stability depends on its "capital stock"; that is, the sand constituting the beaches and barrier islands. This capital (sediment) is being consumed through expenditures (demands) made by climatic and geologic processes: namely, severe storm impacts and waves generated by prevailing southeast winds. "Income" (sediment input by rivers) has generally been inadequate in modern times except near river mouths.

Shoreline erosion has already destroyed piers, seawalls, and houses. Many other structures will be destroyed in only a few years if past erosion rates continue. A notable example of this imminent hazard is the rapid erosion in the South Padre Island area, where a construction boom has placed large numbers of inhabitants in danger. Although the surf has not yet reached the beachfront condominiums, erosion is consuming land at a rate that further exposes inhabitants to possible hurricane surges or to wave action during even a moderate storm.

Subsidence

Subsidence differs from hurricanes and shoreline erosion in that it is largely the result of human activity. It is caused by the extensive withdrawal of groundwater from unconsolidated coastal aquifers.

Subsidence occurs naturally whenever earth materials are compacted. This compaction can occur at the ground surface or at depth; in both instances the surface of the ground may be lowered. Subsidence accompanies compaction when water trapped between unconsolidated sediment grains is squeezed out by any kind of pressure. This process occurs to some extent in all newly deposited water-laid materials. It is part of the ultimate transformation of loose sediment (sand, silt, and clay) into hard rock (sandstone and shale). Natural compaction and subsidence, however, is generally so slow as to be imperceptible.

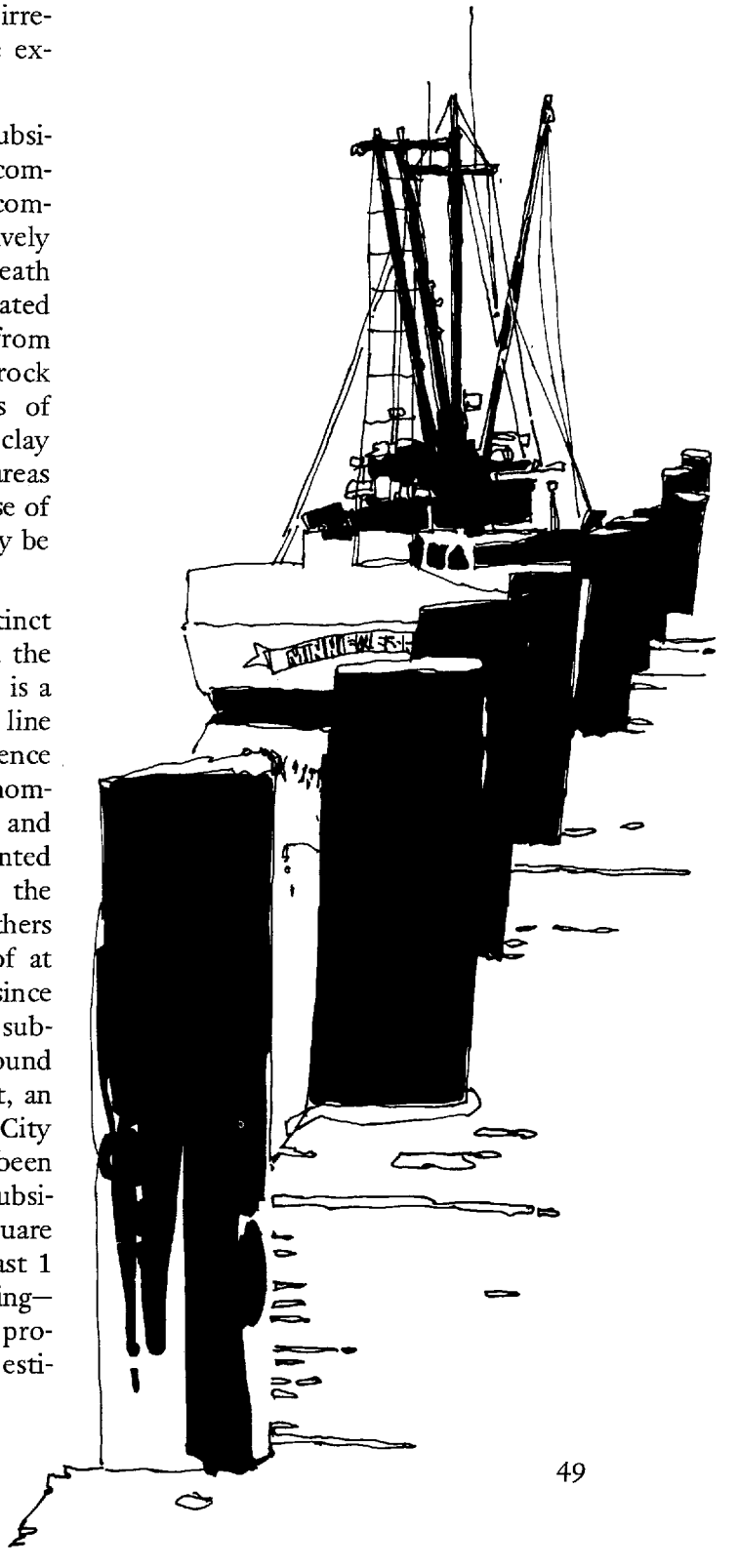
Over a period of years man has hastened this natural "dewatering" process in the Texas coastal region by pumping out millions of acre-feet of groundwater. Groundwater provides much of the freshwater supply for many coastal municipalities and industries, and to some extent for agriculture as well. Most of the demand for groundwater exists in the greater Houston

area, where recent rates of pumping have been about 650 million gallons per day (Brown and others, 1974).

The aquifers that yield this bountiful water supply consist of alternating layers of sands and clays. The sands, being more permeable, yield water rapidly. As water is removed from these sands, pressure is imposed on the intervening clays which, in turn, are slowly drained and begin to compact. This compaction process continues as long as water is pumped from adjacent sand layers. The cumulative effect of this compaction process is a continuing lowering of the ground surface. Subsidence is irreversible because the clays, once compacted, can never be expanded to their original thickness.

The exact rates of underground compaction and subsidence at the ground surface are functions of the geologic composition of sediments below the surface. This sediment composition is highly variable from place to place. All relatively shallow (to depths of several thousand feet) substrate beneath the Texas coast consists of some combination of unconsolidated sand and clay, and some subsidence will always result from intensive groundwater withdrawal from these kinds of rock materials; however, some areas can sustain higher rates of groundwater withdrawal than others. Areas with fewer clay layers will have less compaction and subsidence. Other areas may have higher groundwater production capability because of their low population density. In these areas, well fields may be scattered to prevent concentrations of large-scale pumping.

Artificially induced subsidence occurs within three distinct areas along the Texas coast. The largest area affected, and the area with the highest subsidence rates and gravest impacts, is a roughly elliptical area 140 miles long that centers on a line between Houston and Texas City. It is thought that subsidence in the Houston area has been a continually increasing phenomenon since at least 1906 (Gabrysch and Bonnet, 1975), and subsidence rates from 1943 to the present have a documented correlation with both groundwater pumping rates and the lowering of the water pressure in the aquifer. Brown and others (1974) point out that the areas affected by subsidence of at least 1 foot have doubled approximately each decade since 1943. About 230 square miles of land near Pasadena have subsided more than 5 feet, and there has been a maximum ground lowering in this area of 8.5 feet. Elsewhere along the coast, an incipient subsidence center has been mapped in the Bay City vicinity. A broad, but as yet insignificant, depression has been noted in Jackson County, and another center of incipient subsidence occurs near Corpus Christi. In all, more than 3,000 square miles of upland along the Texas coast have subsided at least 1 foot. Even if the cause of subsidence—groundwater pumping—were stopped immediately, the compaction and subsidence process would probably continue long enough to cause an estimated 15 to 20 percent of additional ground lowering.



The subsidence problem poses extremely difficult questions to both the public and private sectors. It is caused by society's demand for fresh water, and, indirectly, by society's demand for goods whose production requires fresh water. People who suffer most from the effects of subsidence, however, may not be major contributors to it. In this light, "justice" in the form of damages awarded by the courts would be extremely difficult to mete out.

Private landowners lose property as bay waters encroach onto areas that have subsided. The Brownwood subdivision of Baytown has been entirely inundated in this way. The lowering of the ground level also subjects increasing numbers of areas to shoreline erosion, to possible inundation by hurricane surges, and to various other dangers or nuisances such as malfunctioning water and sewage lines. Another dangerous process that is partly caused by subsidence is faulting,* which results in the breakage of structures and increased maintenance costs for roads, pipelines, and utilities. Attendant to pipeline or utility-line rupture are risks of fire, asphyxiation, poisoning, pollution, and electrocution. As with other processes, the severity of the hazard imposed is relative to the number of people or types of facilities affected.

Groundwater extraction was once thought to be an inexpensive means for supplementing surface water supplies along the Texas coast. Now, it is evident that development of the groundwater supply imposes unforeseen costs; namely, damage costs related to subsidence (Warren and others, 1974). Moreover, there are "nondollar bidders" for a share of these water resources. These "bidders" are the bays and estuaries, their associated natural systems, and their derived economic systems. The bays and estuaries depend on adequate freshwater inflows to maintain their levels of marine life.

Bay and Estuarine Management

The Texas bays and estuaries are a great public resource. They provide habitat for fish, birds, and other wildlife; they contain important archaeological and historical sites; and they are scenic assets. Concurrently, the bays and estuaries sustain numerous intensive human uses. They provide shipping lanes for coastal cities; petroleum is produced from within their reaches; and their waters and lands are appropriated for other intensive activities.

Generally, these waters can sustain intensive uses without appreciable adverse effects, but they are not all equally suited for all uses. Intensive human demands on critical natural areas such as tidal marshes and submerged grass areas cause problems. These problems will be documented, first by a discussion of marsh products that are of value to society, an explanation of the way a tidal marsh functions, and a description of the risks of misusing these areas. Second, selected examples of intensive

*Fracturing and displacement of rocks or sediment comprising substrate.

human demands on marsh systems will be examined to show their possible impacts on these areas. Two of these demands are the diversion of fresh water and the placement of dredged material.

Uses and Values of Tidal Marshes

Tidal marshes are tracts of soft, wet land often near bay margins. They are occasionally or frequently inundated by tidal waters. Characterized by various salt-tolerant grasses, these areas produce vast amounts of organic material by photosynthesis. On the average, salt marshes produce a net quantity of 8.9 tons of dry organic material per acre per year. Only tropical rain forests, coral reefs, and some algal beds produce more abundantly. The best farmlands are only half as productive.

This high level of productivity supports extensive food chains within the marsh and in adjacent bay systems. In areas of New England, the South Atlantic, and the Gulf region, material produced in the marsh has been shown to be the major source of organic material supporting the entire estuarine food web (Nixon and Oviatt, 1973; Odum and Skjei, 1974). Because of the high productivity of marsh plants, a tidal marsh can assimilate high levels of municipal and industrial wastes and incorporate them into its yield of organic material. Tidal marshes serve as nursery areas for various estuarine species, and a variety of furbearing animals, game fish, and waterfowl—including several "endangered species"—rely upon the tidal marsh for habitat. Tidal marshes also aid in erosion control by absorbing wave energy and serve as temporary floodwater buffers.

Human uses supported by the marsh system include

—waterfowl management and hunting;
—livestock grazing;
—commercial and sport fishing;
—waterborne transportation;
—recreation and aesthetic enjoyment;
—mineral production;
—mariculture, and
—waterfront land development for resorts, recreation, and second homes.

It is unlikely that a marsh system could sustain all of these uses at any one time in one location, since a few uses listed may preclude some or all of the others. However, marsh systems typically provide many values simultaneously, and even land developments and navigational improvements can be designed to minimize their adverse impacts upon the total marsh system.

Operational Characteristics of Tidal Marshes

Both tides and freshwater inflows wash inorganic nutrients into the marsh, where they are trapped by the anaerobic* sediments and used by populations of microorganisms. Inorganic nutrients in the marsh sediments are then incorporated into plant material that decays and is recycled by abundant micro-

*Living in the absence of free oxygen.

organisms. The rapid cycling of inorganic nutrients into plant material, decomposition of this material, and reincorporation of inorganic materials into sediments for further plant or animal use is a characteristic feature of the marsh area. This process is often assisted by wind or tidal action, which stirs the decaying mass, mixing the sediment and distributing materials over the marsh surface. Sunlight and warmth are also important to marsh productivity.

In most areas some amount of salt water is necessary to sustain tidal marshes. The level of salinity defines the character of a marsh—whether freshwater, brackish water, or saltwater—and determines which species of plants and animals will occur there. Too much salinity, however, reduces both marsh productivity and the rate at which marsh sediments take nutrients from the water. This underscores the importance of freshwater inflows for diluting salt water.

A variety of physical, chemical, and biological circumstances produce large amounts of organic material that are used both within the marsh system and in adjacent estuarine systems. In addition, marsh detritus, associated microorganisms, protective habitat, and other environmental conditions make the marshes prime nursery areas for economically important species. Thus, the marsh is a major source of energy; that is, protein and carbohydrates for natural systems and for man.

The movement of water into and out of the marsh and the internal circulation of marsh waters are essential to marsh productivity. Freshwater and saltwater inflows deliver sediment, nutrients, and various organisms to nearby aquatic ecological systems. In some areas, as much as half of the organic material produced by a marsh is carried by tides or periodic high water to adjacent estuaries, where it is a very important ingredient in estuarine food chains. Another part of the marsh's organic product is consumed by nonaquatic marsh foragers, predators from elsewhere in the marine ecosystem, and by immature forms of various commercial and sports species that use the marsh as a nursery ground.

Risks of Marsh Misuse

Because of the role the marsh plays in the production of food for the populations both within and outside the marsh, any circumstances that impede the natural flows to and from marsh areas reduce the fishery potential of adjacent bays and estuaries. This relationship has been demonstrated in Chesapeake Bay, where a direct relationship between the quantity of detritus produced and the catch of striped bass was observed (Heinle and others, 1975). In Boca Ciega Bay, Florida, large-scale filling of seagrass areas has significantly decreased catches of fishery products (Taylor and Saloman, 1968); and bulkheading of mangrove areas in Lake Worth, Florida, produced marked declines in the catches of redfish, trout, and snook (Woodburn, 1961). In Louisiana, poorly planned road

embankments, ditches, and dredged material placement were shown to have altered the natural hydrology of a marsh-estuary system, resulting in high turbidities and concentrations of fertilizers from the runoff of nearby sugarcane fields (Day and others, 1975); these conditions caused a definite decline in the sports fisheries of the area. In this instance, the gradual change from year to year was virtually undetectable, but after 15 years there was no doubt that a serious decline had occurred.

In Texas, studies comparing undeveloped marshes and bulkheaded or channeled developments on Galveston Island and in Clear Lake showed a sharp reduction in organic productivity associated with the developmental activities (Mock, 1966; Trent and others, 1972; Corliss and Trent, 1971). Specifically, crustaceans, including shrimp, were over three times as abundant in the undisturbed as in the altered areas.

Although it is known that some small changes in marsh environments may have severe or widespread consequences, scientists do not know which functions are being served by specific marshes; therefore, the risks associated with uses of specific marsh sites cannot be fully assessed. Nonetheless, some adverse impacts can be clearly perceived, even if they can only be presented qualitatively. Any discussion of potential impacts must be preceded by an inventory of the present condition of the resource.

The Status of Texas Marshes

Tidal marshlands comprise approximately 400,000 acres, or 27 percent of the state's 1.5 million acres of bays and estuaries, but marshland acreage lost to man-made changes is difficult to estimate. A very conservative estimate would be 53,000 acres statewide, or 14 percent of the present marsh area. In Galveston Bay, an estimated 25,000 acres, or 25 percent of the bay's marsh area, has already been lost.

Submerged lands and wetlands within the State of Texas are partially managed by each of a number of state agencies and by the U.S. Army Corps of Engineers. Texas does not have a comprehensive program for managing wetlands.

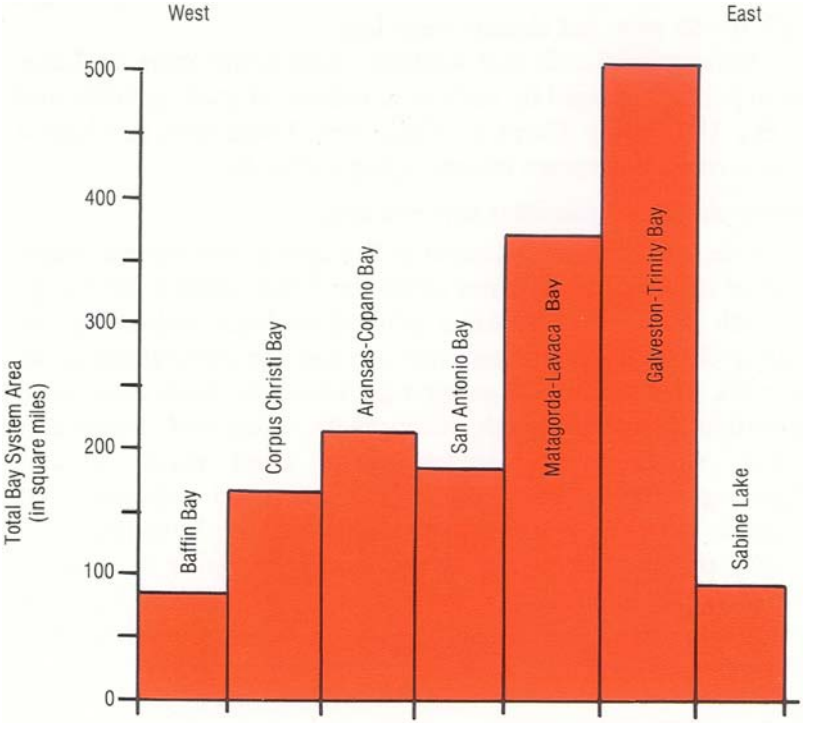
Freshwater Inflow to Bays and Estuaries

One of the most vulnerable linkages in the natural maintenance of bays and estuaries along the Texas coast is the inflow of fresh water that sustains general ecologic well-being, including the biologic productivity of most commercial and sport fisheries. The dilution of saline tidal waters by fresh water is an important factor in marsh productivity. Moreover, freshwater inflow, which comes predominantly from major streams emptying into the bays, carries nutrients and sediment that maintain marsh systems both biologically and physically. That is, they provide basic materials used in the estuarine food chain, and they also maintain a delicate balance of sediment that prevents compaction and complete inundation, and thus the loss of marsh areas.

Occasional extreme freshwater inflows due to flooding are beneficial to bays and estuaries. Floods flush pollutants from bays. They also scour tidal inlets and thus ensure continued free exchanges of water, sediment, and biota. Even though these short-term extremes may be harmful to many kinds of estuarine organisms, desirable species usually repopulate with increased vigor, because parasites and disease-carrying bacteria and viruses are also destroyed by the flood.

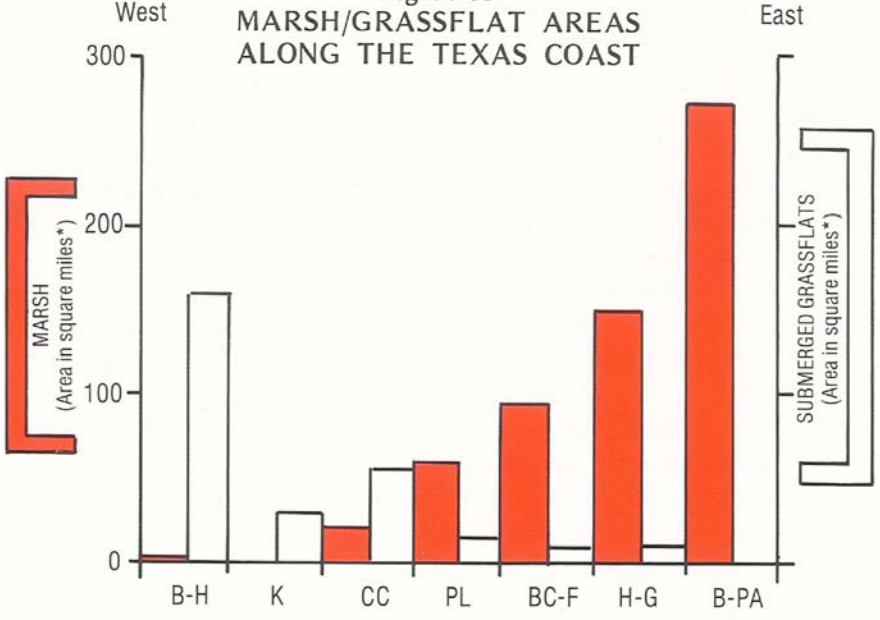
The Texas bays and estuaries are adapted to periodic climatic extremes, both floods and droughts. These areas are resilient and provide renewable resources in spite of highly variable freshwater inflows. Nonetheless, there are distinctive conditions in each of the bay and estuarine systems that reflect long-term adjustments to differing amounts of fresh water and attendant nutrient and sediment supplies. As the climate becomes progressively more arid along the coast from northeast to southwest, bays become either progressively smaller or progressively more saline (fig. 12). Bay size is not actually a function of present river discharges, however, so there are exceptions to this trend. For instance, Sabine Lake is disproportionately small in relation to its present inflow, although it "compensates" by being the least saline of all Texas bays. Further exceptions to the bay size and stream discharge relationship occur where rivers have totally filled their estuaries and flow directly into the Gulf of Mexico, as do the Brazos and the Rio Grande.

Figure 12
BAY AREAS ALONG THE TEXAS COAST



A more direct relationship between present freshwater inflows and estuarine systems is revealed through comparison of the marsh acreage associated with each of the bay systems. Marshes decrease in size and number from the humid upper coast to the semiarid lower coastal areas (fig. 13). Even though there is less marshland in the area, bays along the lower Texas coast are very productive in fish and shellfish (Breuer, 1957). This phenomenon can be explained by the larger areas of submerged grass along the lower coast, especially in and near Laguna Madre. The inverse relationship between submerged grass areas and marshes from humid to arid areas indicates that submerged grass provides many of the same ecological needs in areas of less freshwater inflow that marshes do in areas of higher inflow: high primary productivity, an intricate food web among organisms, and protective cover for juvenile or larval aquatic species. Like marshes, grassy submerged areas contain a delicate balance of sediment, nutrients, and fresh water. They are shallow and have low turbidity (thus require less sediment input). The plant and animal life in these productive areas appears to be delicately adapted to low freshwater inflows, and thus to higher salinity. Even though the freshwater inflows that sustain the productivity of the bays and lagoons of the lower coast are small, it is important that some critical minimum be maintained.

Figure 13
MARSH/GRASSFLAT AREAS ALONG THE TEXAS COAST



B-H BROWNSVILLE-HARLINGEN
K KINGSVILLE
CC CORPUS CHRISTI
PL PORT LAVACA
BC-F BAY CITY-FREEPORT
H-G HOUSTON-GALVESTON
B-PA BEAUMONT-PORT ARTHUR

*Figures provided by Bureau of Economic Geology

Scientific studies have attempted to quantify the relationship between freshwater inflow and bay and estuarine biologic productivity. However, beyond establishing generalities, such as the high correlation between the amount of marsh area and increased freshwater inflow, there have been few unchallenged conclusions. Many variables can affect total biologic productivity, and they are as yet poorly documented. Furthermore, species respond differently to different inflow conditions. Occasional extreme climatic events, both droughts and floods, may have either beneficial or adverse effects that are not completely understood.

Deficiencies in man's understanding of natural systems make it difficult to determine the proper allocation of wetland resources. Man competes with the bays and estuaries for fresh water. Upstream diversion rates of fresh waters cannot be based on an attempt to maintain optimum bay and estuarine productivity at the present time because the relationships between the timing or amount of freshwater inflow and maintenance of these complex ecosystems have not been fully assessed. Consequently, freshwater allocation to wetlands is at best managed almost blindly; fresh water may be overallocated to one bay and underallocated to another. Short-term releases of fresh water during critical periods might result in the same ecological benefits as sustained year-round flows. As yet, however, not enough is known to allow the use of these "timed pulses" of fresh water in managing Texas bays and estuaries.

The bays and estuaries have maintained their viability in spite of droughts. However, extensive human demands will worsen the effects of future droughts on the wetlands and their biologic products. The allocation of fresh water is currently managed in Texas by the Texas Water Rights Commission, and most river waters of the state are overallocated. That is, permitted diversions exceed the minimum discharges expected during drought times (table 4). Extremely low flows and attendant poor water quality during droughts threaten the bays and estuaries because a base flow to the wetlands is not assured.

It is both valid and necessary to establish priorities among all bidders for freshwater resources, so that in times of drought fresh water can be equitably apportioned to all uses—human consumption, industrial processes, agriculture, bay and estuarine nourishment, etc. Present knowledge about the freshwater needs of bays and estuaries provides no easy answer to this question. Retentions or releases from reservoirs are now largely administrative decisions, but they should be at least partially based on ecological data.

Dredged Material Placement

Another intensive human use of bay and estuarine systems is the dredging of waterways and placement of dredged material. As has been previously discussed, this activity is vital to the economic well-being of the region. Texas bays are so shallow

Table 4
INFLOW AND DIVERSION DATA—TEXAS BAY SYSTEMS

	Bay Area Acres	Mean Annual Discharge Acre-Feet	Current Permitted Diversion Acre-Feet	Minimum Annual Discharge Acre-Feet	Actual† 1974 Diversion Acre-Feet	Minimum Monthly Discharge Acre-Feet
Sabine Lake	59,300					
Sabine River		4,783,000	1,956,165	1,275,000	145,761	27,200
Neches River		3,172,000	2,882,884	720,000	582,285	11,100
Galveston Bay	341,000					
Trinity River		4,239,900	3,333,005	660,000	780,481	9,850
San Jacinto River		497,700	973,951	171,200	230,985	4,060
Lavaca Bay	50,000					
Lavaca River		510,800	119,676	18,180	11,819	15
San Antonio Bay	143,000					
Guadalupe River		1,185,000	1,242,325	95,500	94,163	2,310
San Antonio River		423,100	158,097	71,310	56,310	1,560
Nueces Bay	21,000					
Nueces River		627,400	785,031	97,400	120,238	1,520

Note: Matagorda Bay omitted because Colorado River inflow has not been adequately measured.

†Figure does not account for return flows. Typical return flows expressed as a percentage of original diversion are:

Industrial use — 90%
Municipal use — 45%
Upland Irrigation — 12%
Rice Irrigation — 35%

that dredging is essential to accommodate large ocean-going ships, but not all of the results of dredging are beneficial.

Dredging and spoil placement impose direct impacts on certain bay and estuarine areas by removing substrate from one locality and placing it in adjacent areas. These direct impacts are extremely localized and generally cover only small areas. Direct effects of dredging and spoil placement immediately impact only local substrate and plant and animal life; however, these activities also have indirect and long-term effects. Dredge-and-fill processes change bathymetric conditions, with accompanying effects on bay circulation patterns, erosion rates, salinity levels, sediment distribution, and migration of various aquatic organisms. These indirect effects may be far-reaching over a long period of time. Changes in salinity levels and suspended sediment distribution may reduce the productivity of oyster reefs, marsh areas, and open bays far from the site of dredging. Moreover, channels must be maintained; that is, they must be redredged periodically. The disposal of material dredged for channel maintenance presents additional problems. Poorly planned dredged material placement may unnecessarily cover biologically productive areas or increase the turbidity of the water to a level that is harmful to marine organisms. Sometimes the dredged material contains pollutants.

The problems associated with dredged material placement are frequently complicated by the difficulty of finding economically feasible locations for placement and by the constraints of dredging equipment, as well as by environmental conditions. But the dredging of channels does not always impose adverse environmental impacts; proper placement of dredged materials can actually create new marsh areas, and emergent spoil islands provide rookery sites. All these must be taken into consideration when planning the placement of dredged material.

INSTITUTIONAL PROBLEMS

Information and Resource Management

Information is needed for enlightened management, especially for the management of complex natural systems. All too often, however, information collection is not carried out with the goal of managing resources. Management efforts are frequently frustrated by a lack of information about a resource, by duplicative information about another resource, and, perhaps worst of all, by the absence of a line of communication between data collectors and managers when valid information exists. All three types of information mismanagement presently occur on both state and federal levels.

The attempted management of complex resources without an adequate information system ensures that the public will suffer at least twice—once because tax dollars are misspent for invalid, duplicative, or unused information, and again because of the continuing costs of faulty management decisions. Man-

agement decisions that are made without the best possible information are almost certain to be faulty. Arbitrary decisions may preclude a public resource from a proper use. A public resource may be lost without contest, simply because the public management entity does not understand the resource system in question. Information, too, is a public resource, and one for which the taxpayers have paid dearly.

Information Management Problems

State and federal agencies and institutions are involved in numerous efforts at managing coastal resources. Concurrently, public and private research also focuses on the coast and its resource base. Although public entities, state and federal agencies, and universities have spent approximately $130 million on coastal research over the last 10 years (not including regulation and management expenditures), the state still has no comprehensive information system to ensure that managers of the coast will make use of any of this information. This is a gross misallocation of tax dollars.

Numerous information deficiencies are evident in governmental operations in the coastal area:

- —State lands are "managed" without adequate knowledge of their landward boundaries.
- —Marshlands are "managed" without knowledge of their exact locations, their dynamics, or their productivity.
- —Floodplains are "managed," yet their management boundaries may not coincide with boundaries mapped by state entities doing research in the field.

Moreover, there are many examples of duplication of research, of fragmented data-collecting efforts, of failure to consider an appropriate public information source, and of conflicts between the needs of scientists and those of administrators.

Another information management problem is the failure of government to communicate information to the public. Little effort is made to inform the public at large about resources and their capabilities to sustain various uses. The data that exist are not translated into common language, and thus the general public seldom knows what issues are at stake. This lack of communication is, in itself, conducive to misunderstanding. Some resource management issues are complex and scientists do not always agree on possible solutions. The state should make an effort to present the public with all available interpretations of the best existing data about resources and human uses of these resources.

Finally, information mismanagement is frequently seen in environmental impact statements. Although their purpose is laudable, many have failed in their main intent: assessing the probable impacts of a project on important natural systems. The statements supposedly communicate this assessment to the governmental entities that must review a project as well as to the general public. All too frequently, however, environmental impact statements fall short of their intended mark and do

nobody a service. Some preparers, unsure of important resource relationships, try to document *everything.* They fill volumes with trivia and bury the most pertinent information. Thus, neither reviewers nor the general public can adequately assess the merits of the project in question. Reviewers often approve such massive works simply out of weariness.

At the other extreme, some environmental impact statements fail to cover a project completely, and their deficiencies may not be perceived. A classic example is that of a highway loop that was planned around Taylor, a small town in Central Texas. The main considerations of the environmental impact statement were air pollution and noise—valid concerns in Houston, Dallas, and San Antonio, but not especially relevant in Taylor. The more pertinent issues of substrate stability and flooding due to drainage modification were not addressed. This example is neither uncommon nor extreme among environmental impact statements.

Environmental impact statement preparation and review should force the direction of public data-collection efforts to public problems. This, however, has not been the case. Both preparers and reviewers of these statements have evaded or shirked their responsibilities so that another layer of confusion (accompanied by the unjustified expenditure of public funds) has replaced the expected clear line of communication and purpose.

Causes of Problems with Information Management

The basic cause of the data management problems is that data are collected by agencies and institutions that are separated from managers and regulators, and there are often no formal lines of communication among the various entities. Even if the two functions of data gathering and resource management occur in the same agency, there is often still a gap between the researchers and the managers or policymakers.

Data are often collected simply because the money is available. There is a definite need for the funding of "pure" research with tax dollars, but some publicly funded research should also be directed at public problems. These problems must be clearly defined; then the state's budgetary review process should measure research proposals against the state's needs.

In summary, the state's current programs for managing and studying natural and human resources are fragmented. This is true of statewide programs as well as those in the coastal region. Information management problems impose direct and indirect dollar costs on the people for the operation of government because of duplication of state research efforts, lack of coordination in data collection, and interagency conflicts. Also, even though the state has a mandate to inventory and manage resources in the public domain, the most important management issues are often inadequately addressed.

Permitting

The chief mechanism through which the state implements its coastal management policy is the permitting process.

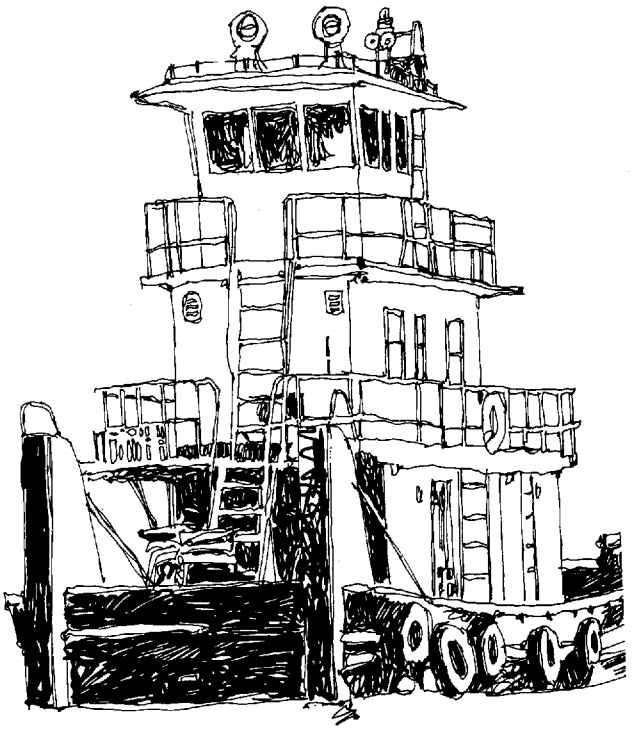
Through the denial or approval of permits, the state regulates a wide range of public and private actions on the coast. The cost of operating the permitting system is paid in part by public funds. The permitting system also places costs on certain private sectors—costs associated with the preparation and submission of applications and with participation in hearings on proposed projects.

It is generally acknowledged that the existing permitting process is exceedingly complex, and there appear to be few attempts on the part of various federal and state agencies to streamline their procedures. During the last five years, most agencies have revised their permit application requirements to demand more technical data, more environmental analysis, more local input, and more public participation. While many of these new requirements may be useful, they are more complicated and more confusing than previous requirements. This added complexity places additional burdens on both government and permit applicants.

A number of permitting problems have been pointed out by various interests on the coast. Some of these problems result from the public's lack of information about the process; others are intrinsic in the procedures of various agencies. Some applicants have found it difficult to determine which division within an agency is responsible for issuing particular types of permits, what types of permits are needed for a project or facility, or even whether a permit is needed. Applicants must either call agency after agency to learn what permits they must obtain or purchase the assistance of someone who is familiar with complex agency requirements. One agency even requires that a permit application be submitted before it will determine whether or not a permit is necessary.

Permitting problems also arise from conflicts of jurisdiction and lack of coordination among agencies. Jurisdictional conflicts can result in noncompliance on the part of the applicant, denial of needed permits, or legal proceedings. Two frequently cited examples of such lack of coordination are the conflict between the Environmental Protection Agency and the Texas Water Quality Board over National Pollution Discharge Elimination System standards and the conflict among the Corps of Engineers, the Texas Parks and Wildlife Department, and the General Land Office regarding dredging permits in coastal waters. Such conflicts often result from a lack of communication between federal and state agencies. Lack of interagency coordination can also result in duplication or inconsistency in monitoring and/or reporting requirements. For example, the Texas Water Quality Board, the Texas Water Development Board, and the Environmental Protection Agency require similar monthly reports from their permittees, as do the Corps of Engineers and the Parks and Wildlife Department.

Each of the problems mentioned can result in unreasonable delays in the granting or denial of a permit. These delays may increase construction costs or cause postponement of a



project and denial or expiration of other permits. For example, if a permit from one agency expires before the applicant can obtain a needed permit from a second agency, the applicant will be placed in the position of having to reapply for a permit from the first agency.

Another inefficiency in the permitting process appears in the area of public notice. Agencies sometimes have differing public notice requirements in terms of both timing and format. For example, the Environmental Protection Agency and the Texas Water Quality Board have similar, but not identical, requirements.

Public notice is intended to invite interested parties to participate in any public hearings which may be held on a permit application, but present procedures that are confusing and cumbersome tend to discourage public participation. Various coastal interests, including both permit applicants and groups who oppose permits, have stated that hearings held by various agencies are often scheduled at inconvenient times in inconvenient locations. This problem is compounded by the failure of many agencies to establish programs designed to stimulate public participation in such hearings.

Budgetary and Policy Planning

Despite many state programs directly addressing problems of coastal management, each of the many agencies responsible for activities that affect coastal resources typically answers only to its own separate board or commission. These boards and commissions are only indirectly accountable to the governor and, under present arrangements, are substantially beyond legislative scrutiny. With the exception of the Texas Water Quality Board and the Texas Forest Service, none of these boards or commissions is accountable to any other board or commission. Given this limited accountability, considerable displays of agency autonomy are to be expected, and interagency coordination occurs only to the extent that it is mutually advantageous or required by law.

The Role of the Governor

If effective coordination of the state's coastal policies and programs is to be achieved, the sources of incentive to coordinate state governmental activities must be examined. The executive branch of state government is accountable in two directions. First, it is accountable to some extent to the Governor's Office. The governor's powers over any office other than his own are at best indirect, except in the case of the Department of Community Affairs, whose executive director answers directly to the governor. The governor has the power of appointment, by which he fills positions on most of the state's boards and commissions as the staggered six-year terms of prior appointees expire. In some cases, he also designates the chairmen of boards and commissions. As the state's chief executive officer, he has considerable opportunity to mobilize public

opinion if he chooses to do so. He joins with the Legislative Budget Board (LBB) in issuing the instructions to agencies for the writing and submission of budgetary requests, and through the Governor's Budget and Planning Office (GBPO), he also reviews those requests and develops his own budgetary recommendations to the legislature. Although this process may offer the governor some leverage over even those agencies headed by statewide elected executives (e.g., the Department of Agriculture, the Office of the Attorney General, and the General Land Office), it is significant that the governor does not originate a state budget request for any office but his own. Rather, he compiles and reviews the proposed budgets and work packages presented jointly to him and the legislature by the state's agencies.

The governor also has the power to recommend legislation, particularly appropriations measures, to the legislature; his decision to support or oppose a measure may substantially affect the calculations of legislators and the success of proposed legislation. Finally, the governor may veto legislation and, more important, he may veto line items of appropriations bills. Although these indirect powers may be used forcefully, they are not absolute, even within the executive branch of government. A very vigorous exercise of all the governor's powers through present channels would be necessary to assure a thorough coordination of all state agency coastal programs.

The Role of the Legislature

A second basic source of incentive to coordinate governmental activities lies in the power of legislative review. The legislature reviews, for approval or rejection, statements of state needs and proposed programs prepared by the state agencies and other groups. However, it lacks the time and expertise to examine adequately the justifications for these statements or program proposals.

In Texas the legislative branch of government is, nevertheless, potentially more powerful than the governor; and it is notable that most of the governor's powers are exercised through the legislative process. The findings of the governor's budgetary review and his recommendations for legislation and appropriations are submitted to the legislature. His veto powers, of course, are subject to the legislative process because they may be overridden, and his more important appointments require the consent of the Senate.

The legislature's power of appropriation, by which it commits state resources to action, has the greatest effect on state agencies. This power is exercised by the appropriations and other committees of each house and by the Legislative Budget Board. The LBB's budget analysts attempt to review agency performance as well as state agency budget requests. Other significant legislative powers include the power to amend state agency jurisdiction and authority and the power to sponsor studies.

Although the scope of legislative power and responsibility seems vast, in practice even the most zealous legislature would find itself limited by insufficient funds, staff, expertise, and time to review the functioning of state government thoroughly. The legislature cannot originate alternative priorities or budgetary packages. It is limited to spot-checking and reviewing the practices, programs, and justifications prepared for it by the agencies.

The Role of the State Agencies

The budgetary cycle begins with the agencies, who independently interpret their various statutory missions into policies, their policies into objectives, and their objectives into programs. This process, usually called the "strategic planning process," is the logical point for agencies to make policy-level decisions about the scope of their missions, coordination, and the most effective technologies for achieving their objectives. The process fails in that the needed policy-level guidance generally is not given.

Typically, strategic planning for Texas' natural resource agencies is done by administrators and technicians. Budget packages are written by personnel absorbed in the day-to-day operations of their agencies. These packages are passed up the line for successive ratifications at higher levels. Little or no guidance is given to the budget writers by those who are responsible for the agency policy choices and commitments implicit in the resulting documents. Thus, policy choices which might improve natural resource agency functioning are probably overlooked, and the opportunities for intraagency and interagency coordination are neglected.

This problem might be corrected if agency budgets were scrutinized effectively by either the GBPO or the LBB. Neither now has the staff, time, expertise, or funds to undertake this kind of review or to submit a counter-budget for an agency or program. There is no independent budget-originating capability in the LBB or GBPO. The agencies hold monopolies in making budgets and cannot be effectively challenged. The budgeting process, then, is the fundamental cause of agency autonomy. Except for the most flagrant abuses, the agencies' work is not reviewed effectively by either the Governor's Office or the legislature, the very governmental bodies to whom the agencies should be accountable.

Without this accountability, there can be no assurance of coordination among executive agencies. Any new coastal management program operating under these conditions could be expected to degenerate into much the same as can already be seen: government by long, drawn-out, complicated negotiations among state agencies, federal agencies, and private sector interests. Agencies act according to their partial and separate perceptions of state policy and needs, each jealously guarding its prerogatives of mission, manpower, and data management, and each tending to court those natural allies in the private and

public sectors who can assist it most effectively in the appropriations process.

Historical Roots of Present Policy Problems

An examination of the last decade of efforts to coordinate the work of the state's natural resource agencies through the Interagency Council on Natural Resources and the Environment (ICNRE) and its predecessor reveals the weaknesses of this management approach. Aware of the need for more comprehensive approaches and solutions to the problems confronting state government, the legislature enacted Senate Concurrent Resolution 68 in April, 1965, creating the Planning Agency Councils for Texas (PACT) to establish a continuing process for interagency coordination and communication. The governor was named chairman of PACT, and various state agencies were named to the councils created under the resolution. Two years later, recommendations made by PACT were incorporated in the Interagency Planning Councils Act (IPCA) of 1967. The IPCA attempted to strengthen and improve the effectiveness of interagency planning and coordination. It contained three significant provisions:

1. It designated the governor as the chief planning officer of the state.
2. It empowered the governor to appoint needed interagency planning councils along functional lines of agency responsibilities, such as natural resources.
3. It directed the governor to create a Division of Planning Coordination within his office in order to facilitate the coordinating activities of the several councils.

One purpose of the IPCA was to achieve coherence, if not unity, of state policy and administration within functional areas. The governor and his staff were clearly charged with the responsibility for achieving this degree of coordination.

The first interagency organization established under the IPCA was the Interagency Natural Resources Council, whose purposes according to its bylaws were

1. to provide a forum for interagency communication and cooperation;
2. to foster the development and protection of the natural resources and environment of the State of Texas;
3. to develop and improve methods of administration, design, operation, and maintenance of projects and programs to ensure the proper development and protection of the state's natural resources;
4. to counsel with the governor and the legislature on problems and needed legislation;
5. to study problems and issues connected with the use of natural resources and the environment; and
6. to provide information and assistance to member agencies and to the public.

Since its inception in 1968, with an original membership representing eight agencies, the Natural Resources Council has

expanded in size and objectives. In 1971, the council changed its name to the Interagency Council on Natural Resources and the Environment. Its membership has grown to 20 agency representatives, including a representative from the Office of the Governor. The governor is chairman of the ICNRE but usually participates in its sessions through a representative from his office. The ICNRE is composed of the executive directors or elected heads of the member agencies. All of these agencies have specific statutory responsibilities in the area of natural resource and environmental management, and each agency has numerous responsibilities which affect and are affected by assigned missions of other ICNRE agencies.

The ICNRE and its predecessor undertook a variety of tasks to fulfill their coordinating role. The seven accomplishments of the ICNRE listed below were described in a council publication as being among the most significant in the 10-year career of the council.

1. Providing qualified technical staff support, top-level advisory assistance, and a variety of services to the governor and his staff in response to proposed federal projects, legislation, and requests for information and assistance.
2. Conducting and completing the comprehensive three-year Coastal Resources Management Program study as directed by the 61st and 62nd Texas Legislatures.
3. Coordinating the collection, processing, and cataloging of basic water-oriented data for state agencies under the direction of the council's water-oriented data programs section.
4. Designing a natural resources information system as the initial phase in the development of a comprehensive data base for all state natural resource programs.
5. Adopting and implementing a "Policy for the Environment" and supporting guidelines and procedures for ensuring adequate environmental evaluation of state-supported projects.
6. Initiating a council task force to assess the existing capabilities and alternatives of the state to respond effectively to land resource management problems.
7. Establishing a remote-sensing task force to develop a plan to define, develop, and evaluate an information system utilizing remotely-sensed data in conjunction with the development, evaluation, and transfer of remote-sensing technology to state agencies.

Despite its accomplishments during the last decade, the ICNRE has proven incapable of achieving the strategic coordination which its founders intended. It is now generally regarded as too ineffectual to be entrusted with the coordination of state natural resource policy. A second look at the achievements of the ICNRE indicates that the coordination it has achieved has occurred at the staff and technical support level rather than at the level of strategic policy planning and coordination.

Providing staff support to the governor in response to federal initiatives; coordinating the collection, processing, and cataloging of basic water data; and establishing a remote-sensing task force are all examples of coordination at the level of technical staff support. This is laudable as far as it goes, but it falls far short of the coordination which is necessary for more productive and more accountable government. Although the efforts of the council have at times approached the difficult issue of policy coordination, this coordination has not been achieved through the council, perhaps because meetings and work sessions are rarely attended by more than one or two policy-level officials. The Coastal Resources Management Program study, which was conducted in part through the ICNRE, did not bring about significant changes in policy coordination. The program produced six studies which resulted in laws that distributed a few additional responsibilities among the already functionally fragmented agencies. Efforts by the council to establish a natural resources information system have skirted the policy-level issues of data management, and the "Policy for the Environment" developed by the ICNRE entirely missed the major areas of policy conflict within state government.

Evidence of Failures in Policy Coordination

Another perspective on the adequacy of ICNRE functioning can be gained by looking at the coastal expenditures of the federal government, state government, COGs, and universities along the Texas coast over the decade in which the ICNRE has existed. First, and perhaps most significant, is the fact that it is extremely difficult to review state agencies' expenditures and performance in a given geographic or subject matter area. The budgeting and accounting formats used by the agencies and by the legislature do not afford an easy glance at major topic areas of state policy; this indicates that no effective review of state policy by topic area is routinely conducted. Over the decade from 1966 through 1975 state, federal, and local governments and universities have spent over $130 million in research and planning for the use of coastal resources. This does not include the day-to-day operational activities of governments, nor does it include construction budgets which, combined, amount to approximately $12 billion over the same period of time. But even though $130 million has been spent for planning and research, the state still has no coherent or coordinated strategy for the balanced exercise of its assigned role in the development and protection of coastal resources.

Another indication of the weakness of the ICNRE is the fact that when the governor sought an entity to coordinate state energy policy and planning, he did not turn to the ICNRE or even to the coordinating council format. Instead, he created a policy-level council, the Governor's Energy Advisory Council, that includes the state's top elected leadership. The rationale for the creation of this new agency, with a budget exceeding $1 million a year, was in part that the state needed a single focal

point for the analysis of energy policy alternatives, the formulation of policy, and review of agency action. It is apparent that the governor, the legislature, and the member agencies of state government who supported the creation of the Governor's Energy Advisory Council consider the present ICNRE structure inappropriate for the high-level coordination and policy planning that is essential in energy matters.

BOUNDARIES

The focus of public interest in the coastal region is the coastal waters and immediately adjacent shorelands—in part because these areas are largely within the public domain, in part because of the importance of resources derived from these public waters, and in part because of the effects of these waters on the uplands. Because the coastal waters are the documented focus of this program, and because the uplands are generally perceived to be beyond the program's scope, it is necessary to delineate the boundary between uplands and coastal waters.

Definition of Coastal Waters

Coastal waters are defined as those areas of water under regular or periodic tidal influence that contain a measurable amount of seawater. The landward extent of tidal influence varies. The Texas coast, unlike the shoreline of the eastern states, is not influenced by a high, predictable range of astronomical tides. While the daily tidal ranges along the Georgia coast may be more than 8 feet, depending on the season, astronomical tides along the Texas coast are seldom more than 1½ feet. The Texas coast, however, is subject to additional tidal actions that are less significant on the east coast: namely, recurrent wind-driven tides that greatly increase the amount of land periodically inundated by the seawater and may extend several feet above the astronomical tidal range. Wind-driven tides must be considered as part of the "mean high tide" along the Texas coast, despite the fact that they are not regular or fully predictable events. The effects of these tides vary in different shoreface areas according to the configuration of the shoreline, the direction and velocity of wind, and the general terrain of the areas they inundate.

The tidelands of Texas have intricate landward boundaries that change daily as well as over long periods of time. Not only do the wind-tides vary from day to day, but erosion, subsidence, and other gradual changes continually modify the line where land and water meet. These changing conditions prevent the establishment of an exact boundary to distinguish the geographic focus of coastal issues (coastal waters and adjacent shorelands) from the balance of the state (uplands).

For this reason, the Coastal Management Program has set a tentative "operational" boundary. A landward limit to coastal waters and shorelands was drawn using the most detailed, up-

to-date, and comprehensive mapping of tidelands available. This boundary was delineated on large-scale maps (standard U.S. Geological Survey 1:24,000, 7.5 minute quadrangle maps) that are on open file at the General Land Office. These detailed maps have been reduced to a scale of 1:250,000 for presentation here (plate 1). It is of foremost importance to recognize that these are operational boundaries, drawn with the knowledge that additional studies will further refine the limits of these tidal areas. Also, ongoing studies will be necessary to maintain accurate boundary maps in the face of dynamic coastal systems.

The Coastal Management Program's maps are based on detailed studies by the Bureau of Economic Geology at The University of Texas at Austin, which used a systems overview of biotic and physical conditions to define map units of coastal waters and shorelands. These maps were drawn by geologists using controlled aerial photographs and topographic maps along with confirming checks by aerial reconnaissance and on-ground fieldwork. The maps from which the coastal waters boundaries were derived represent 25 man-years of research and publication efforts. The source maps are part of the Bureau of Economic Geology's *Environmental Geologic Atlas of the Texas Coastal Zone* (*see* Brown, in progress), which is probably the best comprehensive data source of its kind in the country.

Institutional Difficulties in Establishing a Coastal Waters Boundary

The geologic/biologic "systems" boundary must sufficiently cover the area of primary public concern in the coastal region, which includes mainly the coastal waters and shorelands. Public concern also extends to the noncoastal waters, because the state owns them. There are also other noncoastal areas of uncertain or undocumented importance to coastal waters and shorelands. They include noncoastal wetlands (freshwater marshes and swamps), aquifer recharge zones, and freshwater springs and seeps (points of aquifer discharge). But extension of the boundary along surface watercourses beyond tidal range would present management problems because it would include much of the state. Such a boundary would be unworkable.

The tentative operational boundary does not take in all the areas of concern that extend beyond tidal range, such as hazard-prone areas on the uplands. Consideration of these adjacent areas is incidental to the problems of coastal waters. Still, the users of lands and waters should be aware of these upland areas of concern.

An institutional problem that was recognized in plotting "areas of concern" adjacent to coastal waters was the failure of state and federal agencies to define the geographical limits of their respective concerns clearly. In some instances the difficulty arose because the limits of authority are so diffuse that some policies cover all of the uplands or all of the coastal waters. Other boundaries are unclear because of uncertainty

about the specific location of some resources. However, especially in agencies having major regulatory or planning mandates (as opposed to mandates for research only), this failure to define areas of concern seems to reflect poorly defined policies. These inadequacies pose problems to potential users of coastal (or upland) resources who cannot determine where all the public concerns lie before initiating a project.

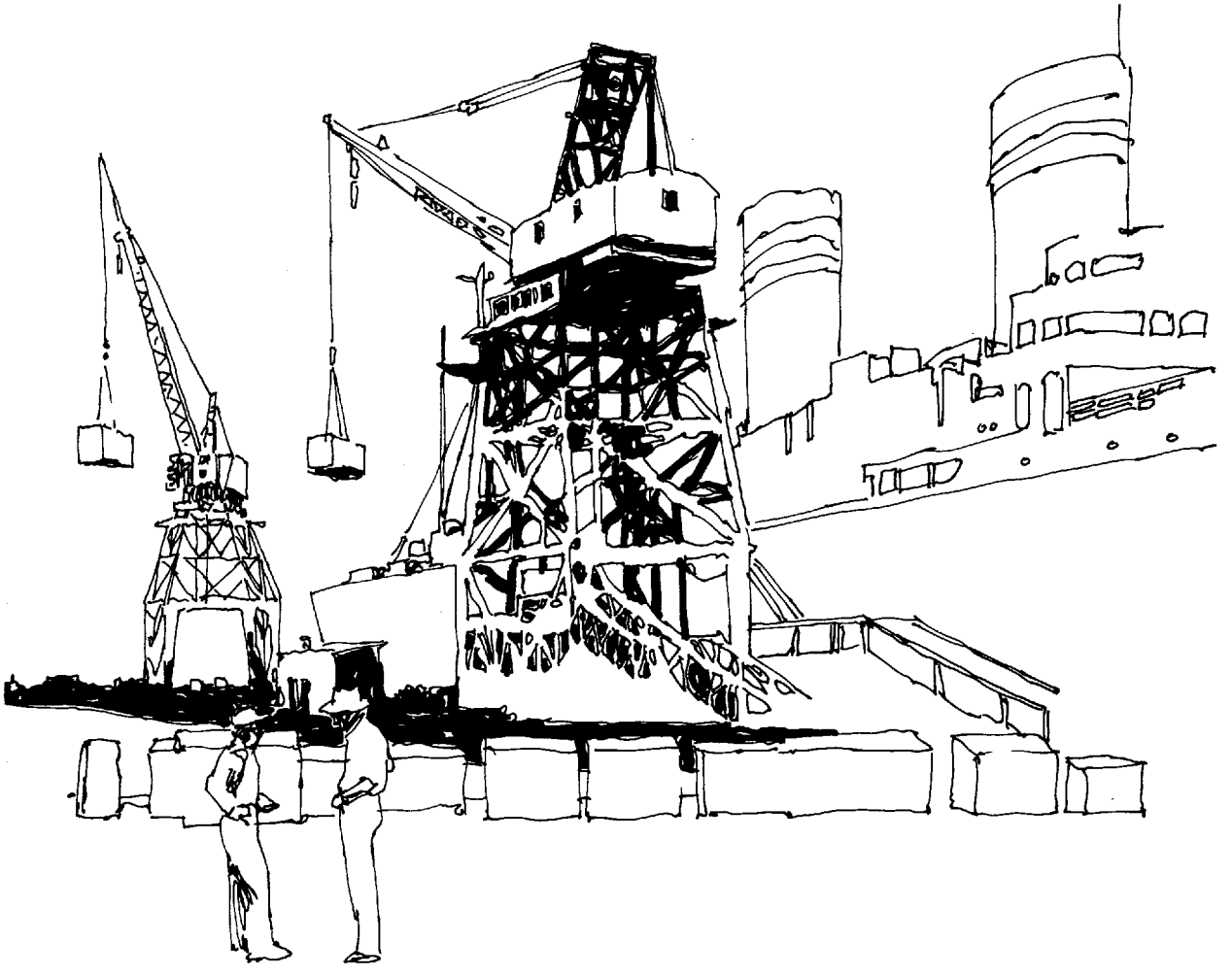
The state does not have a unified voice for policy—different agencies represent different interests and regulate different resources. In fairness to the people they serve, however, the state and federal agencies should be able to define the nature and extent of their concerns consistent with their policies.

SUMMARY

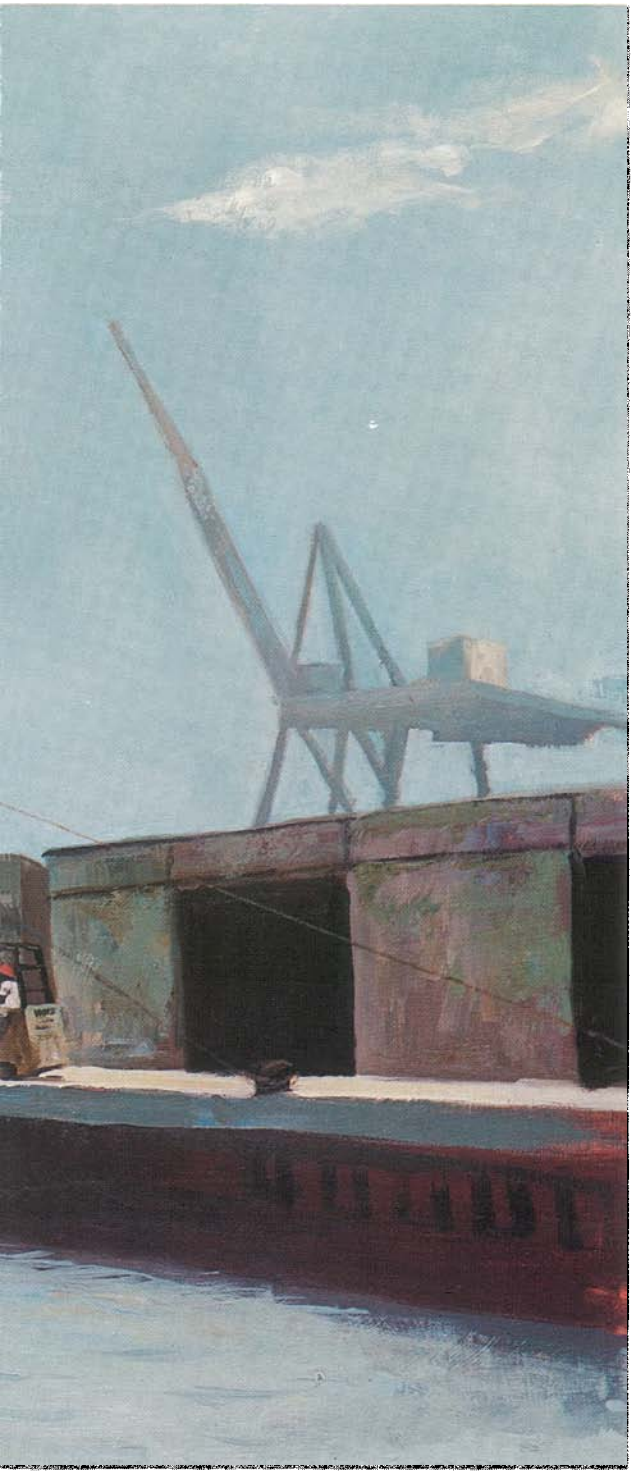
There are numerous alternative solutions to the problems discussed in this report. These alternatives include structural protection from hazards, avoidance of hazardous or ecologically sensitive areas, improved information dissemination, realignment of state policy regarding freshwater allocation, enforcement of coordination for publicly funded data collection, streamlined permitting procedures, the use of the budget as a planning tool, and many more. Solutions that are consistent with local environmental, social, economic, or political conditions should be selected. In one area the effects of hazards may be mitigated by building codes alone. In another, structural measures may be an appropriate alternative. Inland canals might be constructed to provide industrial development with access to coastal waters without appreciable destructive effects on wetlands. While coastal residents have expressed opposition to far-reaching zoning, it might work quite well at the local level. Finally, there is the option of doing nothing. That, too, may be a workable alternative on the local level for local problems.

Where state resources are endangered, however, some action must be taken. The state cannot now manage publicly owned submerged lands properly because there is no clearly delineated tideland boundary. It has also been shown that the state does not even manage its information resources. These shortcomings affect economic activities, the natural resource base, and livability in the coastal area.

It is not the purpose of this report to prescribe solutions for problems in specific locations, but to propose the implementation of a process that can address coastal problems wherever state resources are endangered or misallocated. Such a mechanism must be flexible enough to solve local problems by offering a set of possible solutions. Solutions can be selected from among these possibilities on the basis of site-specific conditions. Flexibility of the management process should also allow choices among institutional arrangements.



CHAPTER IV
A PROPOSAL FOR IMPROVED COASTAL MANAGEMENT



OVERVIEW

The coastal region is a center of many public concerns. Some of these concerns arise from the state's role as the owner of coastal waters, fish, wildlife, and submerged lands. Other concerns spring from the various regulatory and public investment responsibilities assigned to the state over the years—regulating air and water quality and solid waste disposal; regulating the disturbance of bay bottoms and archaeological sites; providing for the public safety and disaster relief; building jetties, seawalls, parks, refuges, roads, and waterways; and promoting the development of marine resources, industry, and tourism. This web of governmental involvement in coastal matters has grown up over many years and shows that coastal management is a well established tradition in Texas.

There are problems, however, with the way the coast is presently managed. The network of coastal agencies, programs, and priorities has been built up in piecemeal fashion, new parts addressing isolated problems without regard to the whole of the coastal economic, environmental, and social systems. As a result, the state's priorities can be easily confused or forgotten, management efforts by one agency may be frustrated by the programs of another, and important state needs may be overlooked. These management problems cost the taxpayers money and shortchange the public interest.

An improvement of the state's present coastal management processes is needed, a redirection which will make better use of present funds, personnel, and programs. This improvement can be achieved within the commission form of state government imposed by the Texas constitution. It can be done without expanding bureaucracy and without increasing the cost of government; and it can be done without infringing upon property rights.

This chapter describes the objectives that were considered in proposing changes in state government, discusses the proposed changes, and presents a summary of the Coastal Management Program's recommendations. The recommendations fall into three groups:

1. A proposed transformation of the Interagency Council on Natural Resources and the Environment (ICNRE) to achieve more effective and accountable government in coastal matters.
2. Proposed changes in data management and decision-making procedures to permit more systematic review of coastal activities by the state's permitting agencies.
3. Recommendations for study and action on a few specific coastal resource issues.

WHAT IS NEEDED: A REDIRECTION OF COASTAL MANAGEMENT

General Policy Objectives

The general principles on which the Coastal Management Program's specific recommendations are based are these:

1. Human well-being should be the first concern of the government in balancing resource use with continuing coastal resource productivity.
2. Private property rights should be protected.
3. Improved coastal management should help solve problems not adequately met by present public or private actions.
4. Where market allocation of resources works satisfactorily, it should continue without undue governmental intervention.
5. Insofar as possible, the current coastal management policies and practices that have proved successful should be retained.
6. Some general policy priorities for coastal management exist, but there should be a systematic way to review and recommend priorities.
7. Coastal management should be fair. The various considerations applied in governmental decision-making on coastal resources and activities should be identified, and decisions should be based on rational standards.
8. A systematic and flexible activity-assessment process is needed to allow the state's agencies to exercise their present authority properly and to avoid arbitrary or outmoded decisions.
9. Decisions must take into account overriding state or national concerns, and a flexible management process will be needed to allow for changes in these concerns.
10. Whenever possible, decisions should be made at a local level of government; the preferences and priorities of local citizens should be considered.
11. The coastal management process and the decision-makers should be accountable to the public—both the coastal residents with immediate interests in the region and all other citizens.
12. Coastal management should be visible and understandable to the people. There must be effective means for the public to be informed about and comment on the workings of the coastal management process.
13. Coastal management should be cost-effective. It should make better use of existing governmental expenditures and strive to avoid new, higher costs in government by focusing efforts on highest priority needs and reducing duplication.
14. Finally, Texas' coastal program should satisfy requirements under the federal Coastal Zone Management

Act of 1972. A federally approved program will be able to extend state authority over most federal activities within the boundaries of the state's management program. Approval will also mean federal matching funds will be available to help implement the program.

Means for Attaining Generalized Objectives

Alternatives

There are many management alternatives. Choices range from doing nothing—maintaining the current system of fragmented and arbitrary management—to creating a superagency or reforming the executive branch of Texas government through constitutional revisions. These extreme courses of action are unlikely to succeed. Changes in the state's coastal management process should be implemented cautiously and be reviewed regularly for effectiveness.

What Is Proposed

The state's coastal management activities can be improved through the use of a *process* based on better agency coordination, a clearly established boundary, and use of the best available information to perform the state's role effectively within the management boundary. The management process proposed by the Coastal Management Program contains four major recommendations:

1. The management process should be concerned mainly with coastal waters, but the boundaries should also contain the shorelands that are closely associated with these waters.
2. The ICNRE should be transformed into a policy-level council for reviewing, proposing, and coordinating the state's coastal program activities. This should make coastal management more accountable to the public, the governor, and the legislature. It should also direct existing funds and personnel to the most important coastal needs.
3. An organized information system, responsible to the Governor's Office, should be established. This system would provide the basis for better permitting and planning decisions on the use of coastal activities. It would also improve agency coordination in existing permitting procedures and other review processes. Finally, the information system would furnish a means for updating the boundaries of the coastal management area and for identifying new coastal data needs.
4. A process should be established for assessing, in advance, the probable economic, environmental, and social effects of specific activities planned in specific coastal locations. As part of this assessment, state agencies should be required to consider the particular concerns of other state and federal agencies in reviewing coastal activities.

RECOMMENDATIONS

Proposed Management Boundary

The proposed boundary for coastal management purposes includes only the coastal waters and closely related shorelands that affect or are affected by the coastal waters. This means that only a fraction of each coastal county is within the management area (figs. 14-20). This narrow boundary excludes most areas under local authority.

The seaward boundary of the coastal management area lies three marine leagues (10.35 miles) offshore in the Gulf of Mexico. The management area extends from the state's boundary with the Republic of Mexico to the State of Louisiana. The landward boundary is difficult to define permanently because areas such as dunes or wetlands change. Coastal wetlands included within the boundary are saltwater marshes, brackish-water marshes, and fresh-to-brackish-water marshes. Only those dunes and blowout areas* that lie next to the Gulf shoreline are included. Dunes on the South Texas mainland are not included.

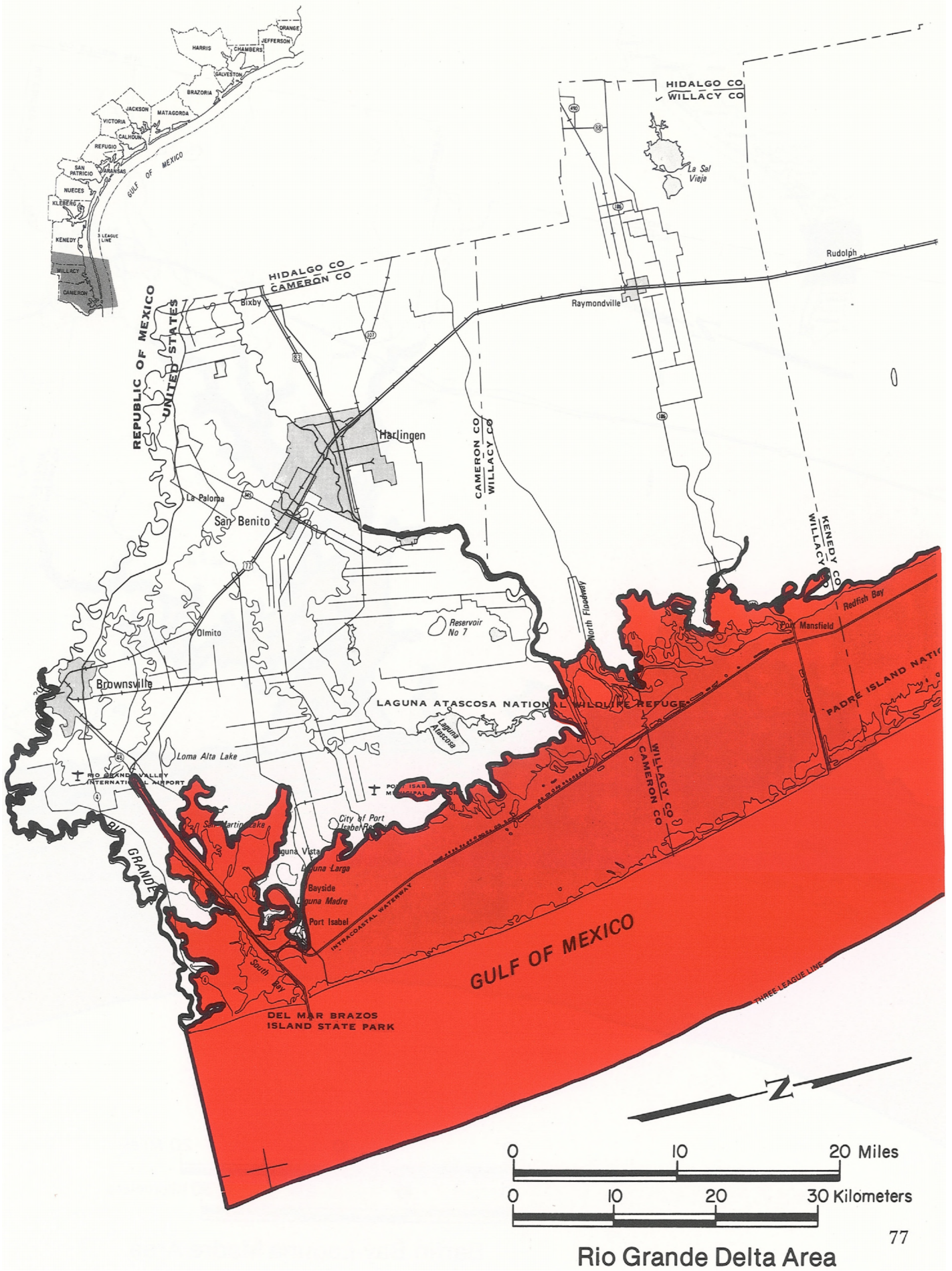
Although the boundary for the proposed management program is based on technical features that are difficult to describe in detail, an operational boundary has been mapped. This boundary will be updated as the physical features on which it is based change. Although the boundary may move slightly, it will include only the areas needed for managing resources closely associated with coastal waters—the fish and wildlife, other natural assets, and navigation channels. This management area boundary is consistent with the expressed wishes of the people of Texas, it is scientifically sound, and it satisfies the requirements of the federal Coastal Zone Management Act.

The coastal waters and shorelands within the management boundary are so closely interconnected that human or natural effects on one area will cause effects on the other. These interactions can be identified and assessed through technical studies of coastal resource areas. These "resource areas" of coastal waters include the nearshore Gulf, inlets and tidal deltas, river-influenced bays, medium-salinity bays, restricted bays, hypersaline bays and lagoons, oyster reef areas, grassflats, channel areas, submergent spoil, coastal lakes, and tidally influenced streams. The shorelands include beach and shoreface areas, wind-tidal flats, coastal wetlands, emergent spoil, active dune areas, and active or potentially active washover channels.

The flows of living and nonliving materials among the various resource areas make it impossible to separate an activity's effects on shorelands from its effects on coastal waters. For example, there is no logical means for separating the beaches from the dunes. They are both the result of long-term wave and wind action along the shoreline. Similarly, there is no logical break between marshes and tidal creeks or bays, or be-

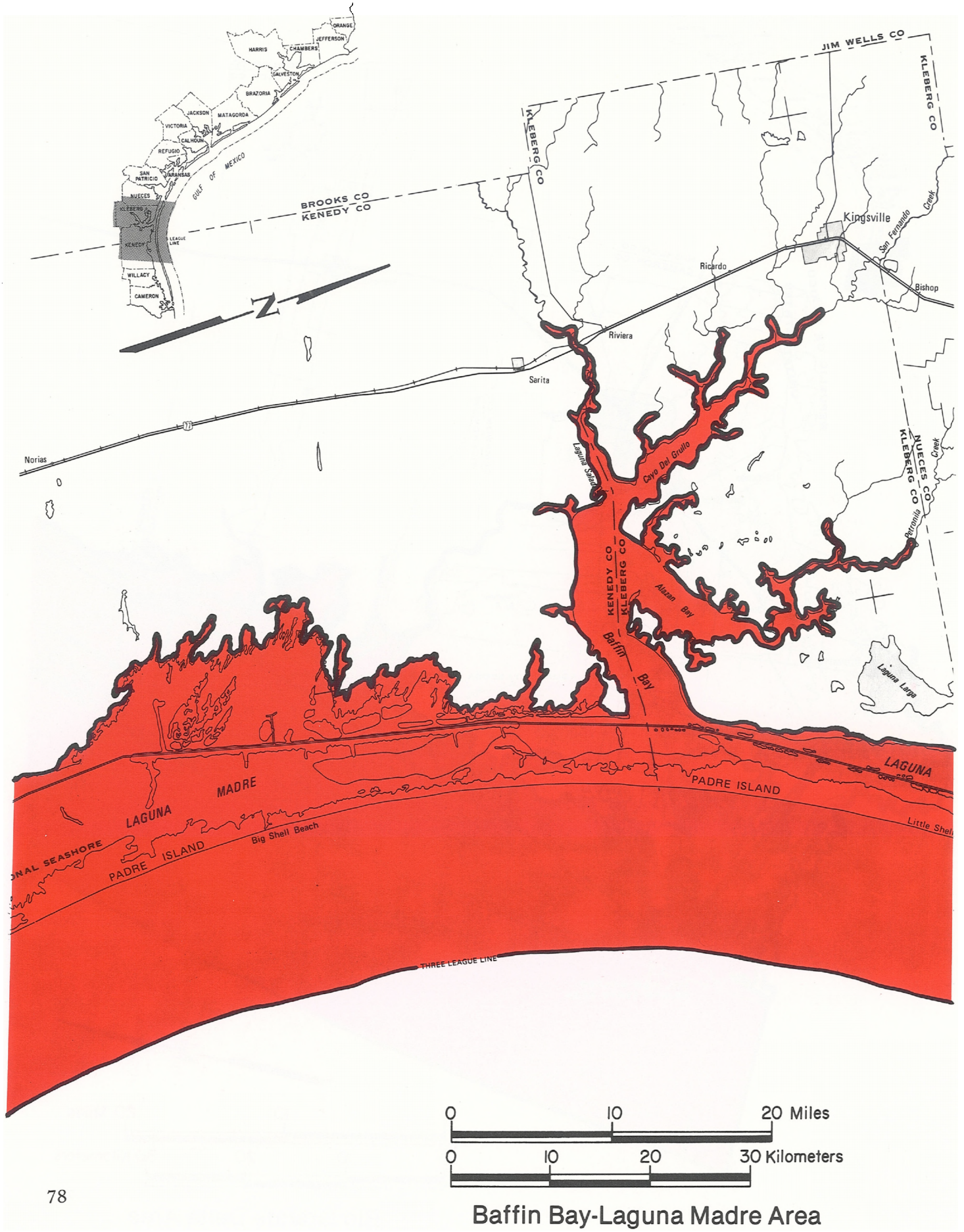
*"Blowout areas" are areas severely eroded by the wind.

Figure 14
RIO GRANDE DELTA AREA



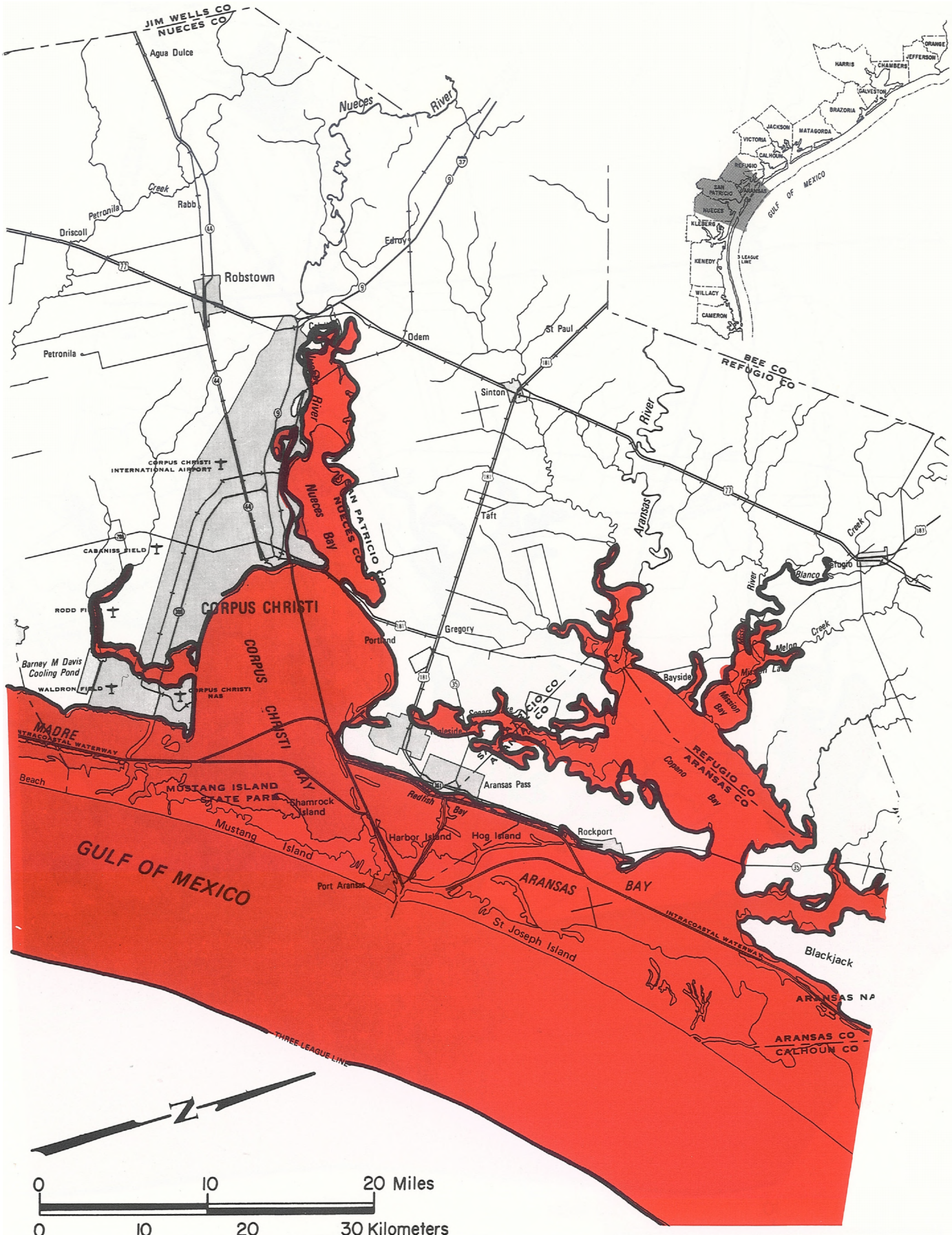
Rio Grande Delta Area

Figure 15
BAFFIN BAY-LAGUNA MADRE AREA



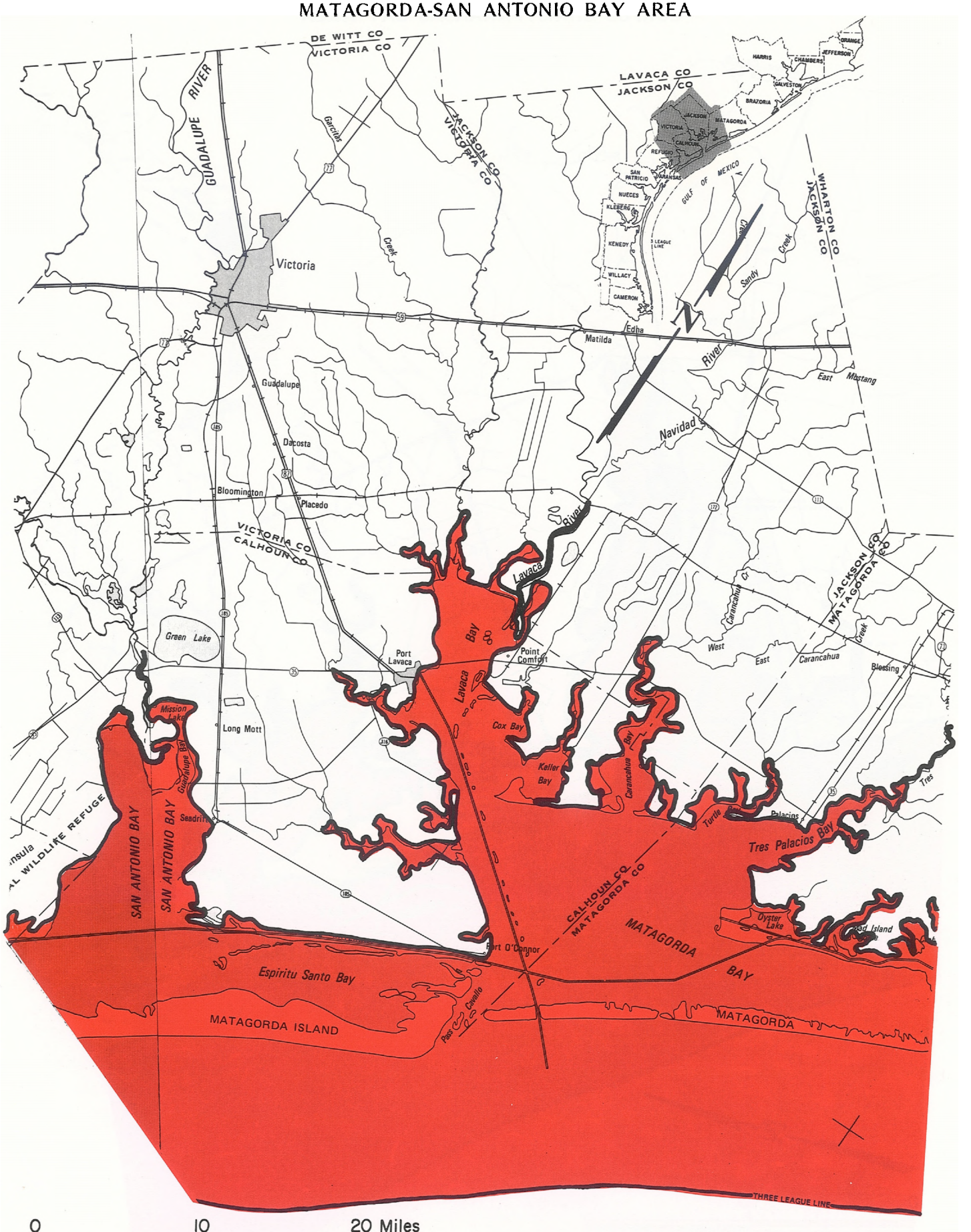
Baffin Bay-Laguna Madre Area

Figure 16
CORPUS CHRISTI-ARANSAS BAY AREA



Corpus Christi-Aransas Bay Area

Figure 17
MATAGORDA-SAN ANTONIO BAY AREA



Matagorda-San Antonio Bay Area

Figure 18
BRAZOS-COLORADO DELTA AREA

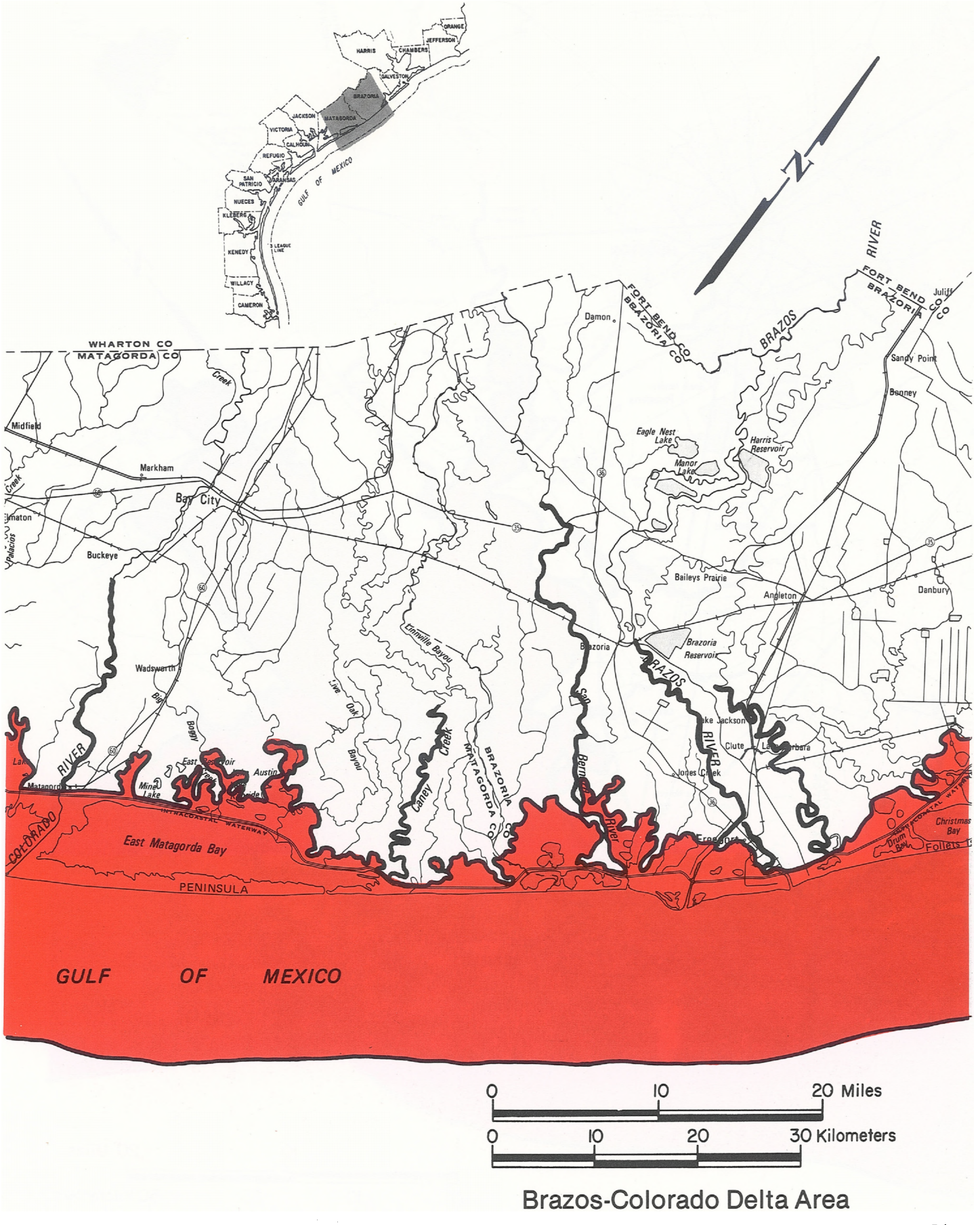
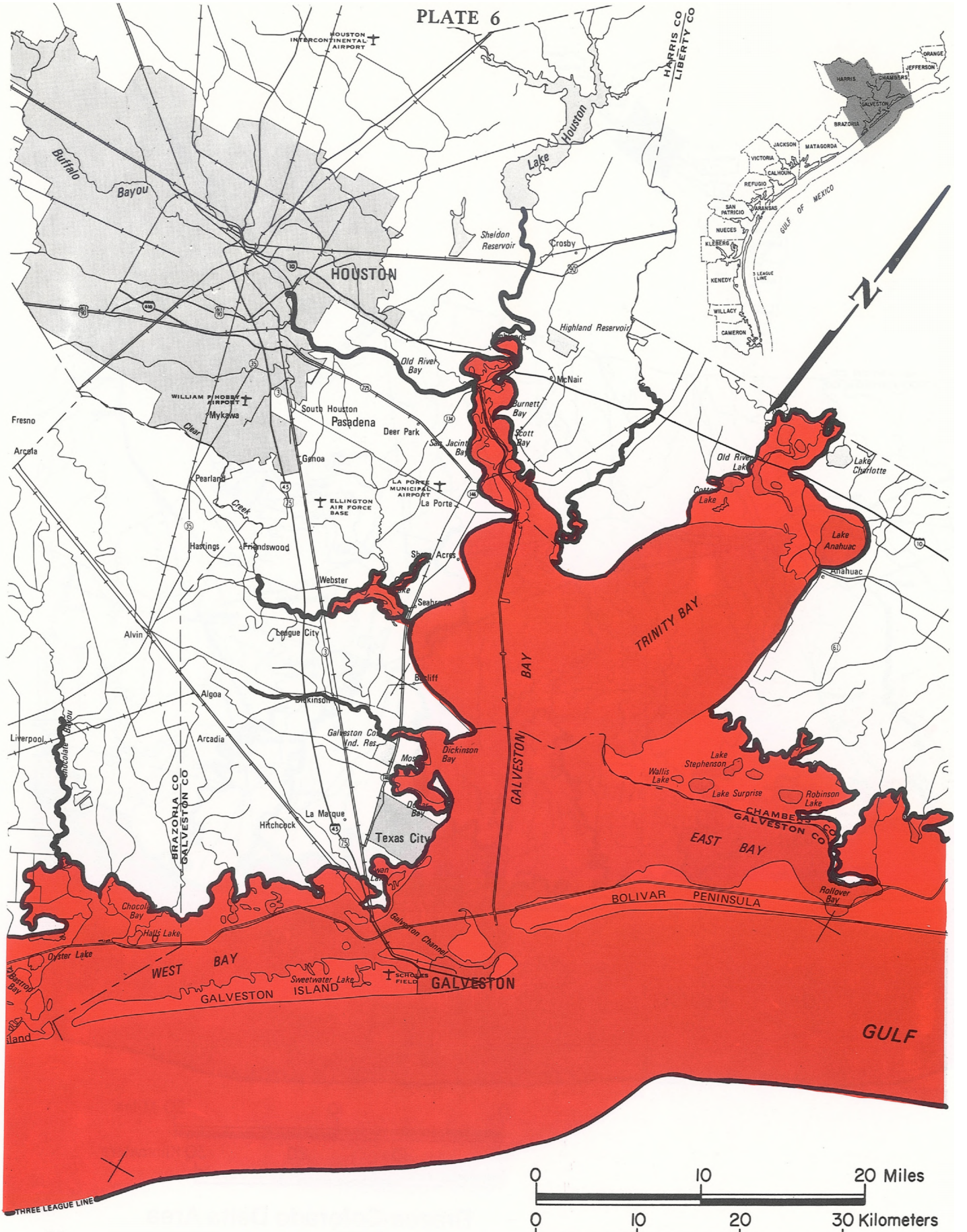
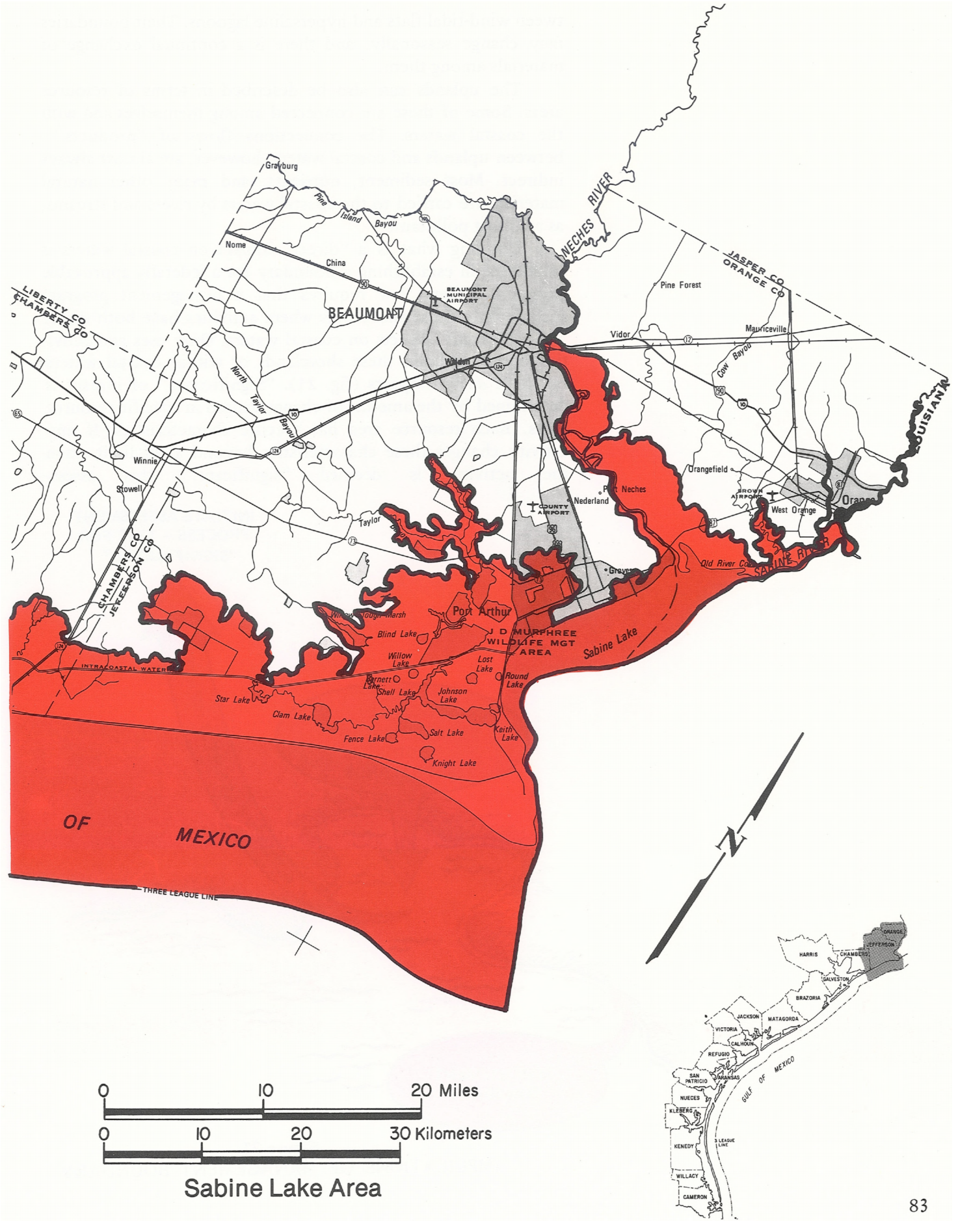


Figure 19
GALVESTON-TRINITY BAY AREA



Galveston-Trinity Bay Area

Figure 20
SABINE LAKE AREA



tween wind-tidal flats and hypersaline lagoons. Their boundaries may change seasonally, and there is a continual exchange of materials among them.

The uplands can also be described in terms of resource areas. Some of these are connected among themselves and with the coastal waters. The connections—flows of "products"—between uplands and coastal waters, however, are almost always indirect. Most sediment, nutrients, and many other natural materials are carried to the coastal waters by rivers and streams, as are most pollutants.

Deciding what is a "direct" impact on coastal waters is important in establishing a boundary for a federally approvable program. Federal law requires that a management program include only those shorelands where activities have both direct and significant impacts on coastal waters. Only uses and activities occurring upon these shorelands or within coastal waters can have *direct* impacts (fig. 21). "Significance" of impact is determined by the amount of change caused in specific resource areas. Each resource area has specific characteristics. If any activity changes these characteristics beyond a set limit, then the activity is deemed "significant." this assess-

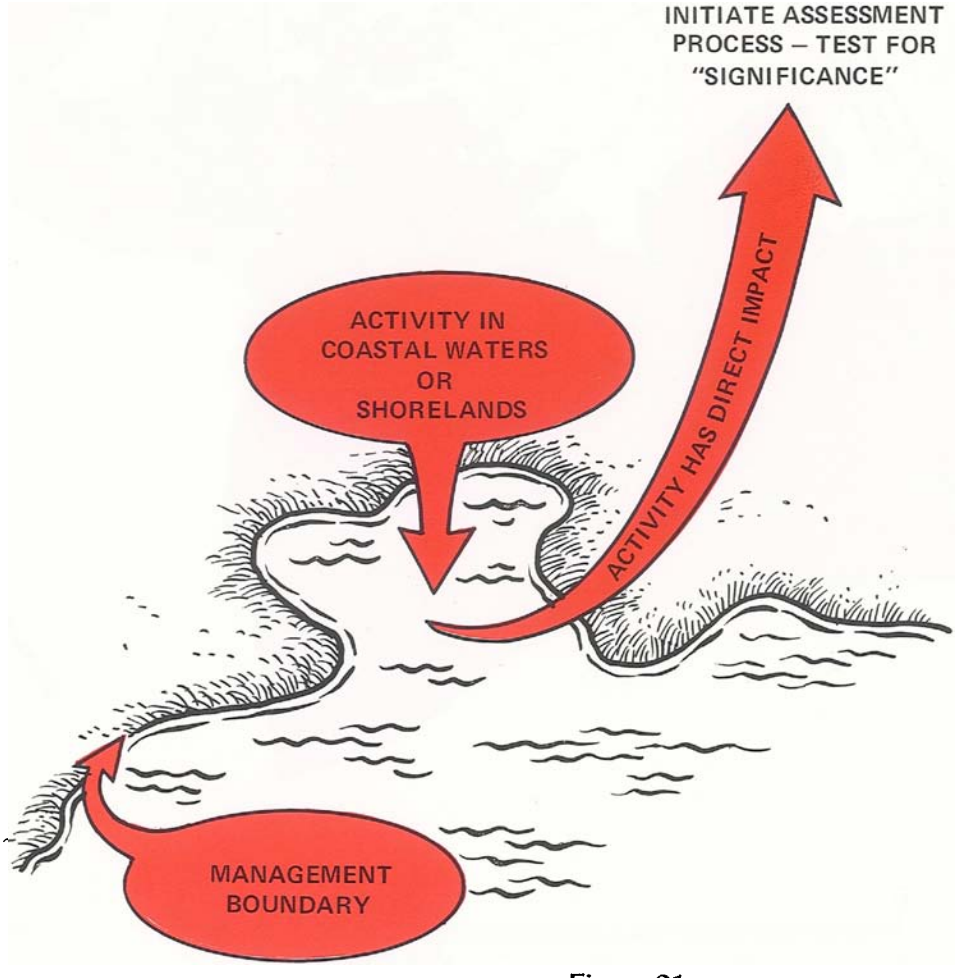


Figure 21
IMPLICATIONS OF MANAGEMENT BOUNDARY

ment does not determine whether an activity resulting in a direct and significant impact upon coastal waters is permissible or not; that is a judgment which must be made by the state's various experts, its agencies.

Significant impacts on coastal waters can originate from the noncoastal waters or from the uplands, but only when the activities generating these impacts occur directly on coastal waters or shorelands can there be direct impacts on coastal waters. Indirect impacts on coastal waters may be important, but they are beyond the scope of a coastal program as such (fig. 22).

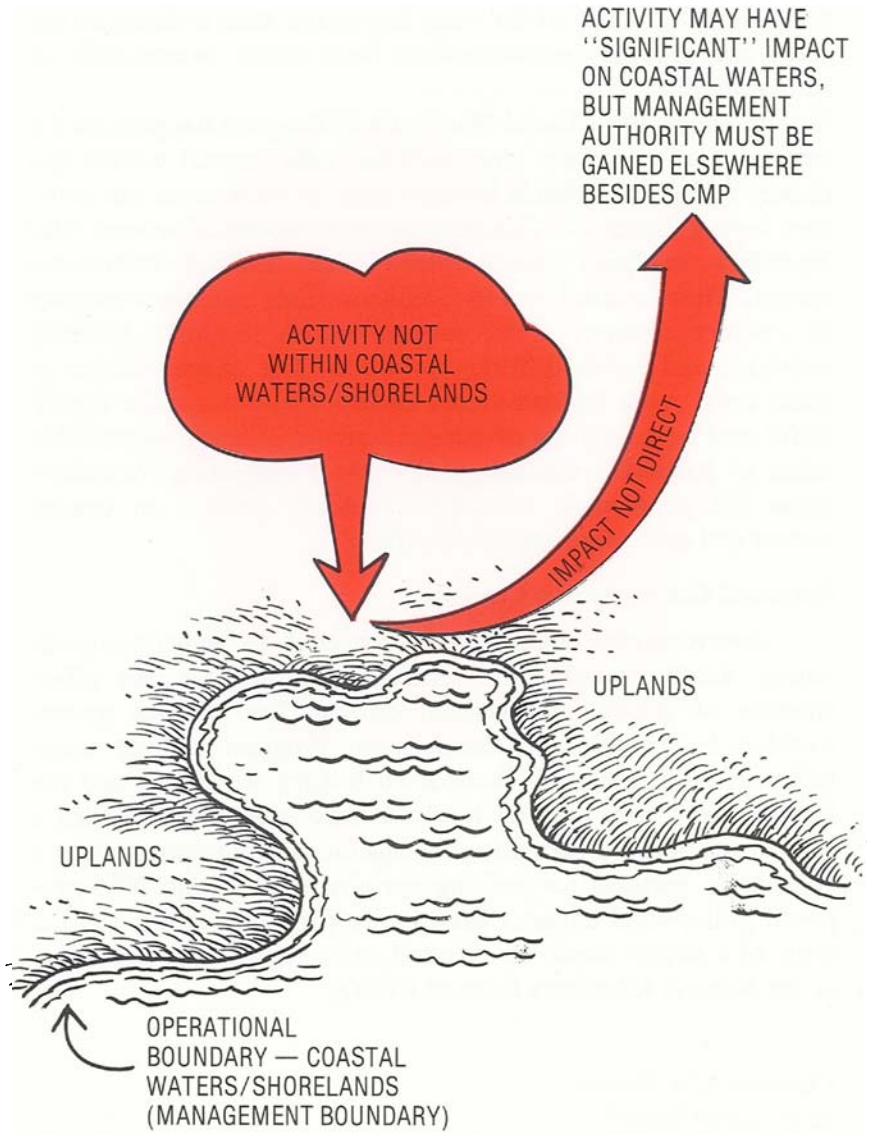


Figure 22
ACTIVITIES BEYOND MANAGEMENT BOUNDARY

Coastal waters and shorelands contain areas of concern to many state agencies. Some of these concerns are vague and of poorly defined geographic extent—a university's research interest in all coastal waters, for example, or an interest in all coastal waters because they may hold undiscovered historical or archaeological sites. Beyond these general concerns in coastal waters, however, there are some specific geographic areas of special importance to current state policy. These are the state's "areas of particular concern," and identifying them as such alerts potential users of those areas to specific state programs and policies. Mapping the geographic limits of the most important state concerns and keying the mapped areas to specific programs, policies, and statutes are important steps in coordinating public policy. These areas of particular concern illustrate the geographic scope of the most important state policies on the coast and provide decision-makers with better information on state policy.

In short, the Coastal Management Program has proposed a management boundary that includes only coastal waters and closely related shorelands because only in these areas can activities have a direct *and* significant impact on coastal waters. This boundary excludes most upland areas and all noncoastal waters. These coastal waters and shorelands contain a number of distinct resource areas, each of which supports different activities and yields different products. The characteristics of these areas must be considered in order to predict the significance and permissibility of coastal activities. Clearly identifiable areas of particular concern within the management boundary show the geographic coverage of public policies in coastal waters and associated shorelands (fig. 23).

Proposed Governmental Changes

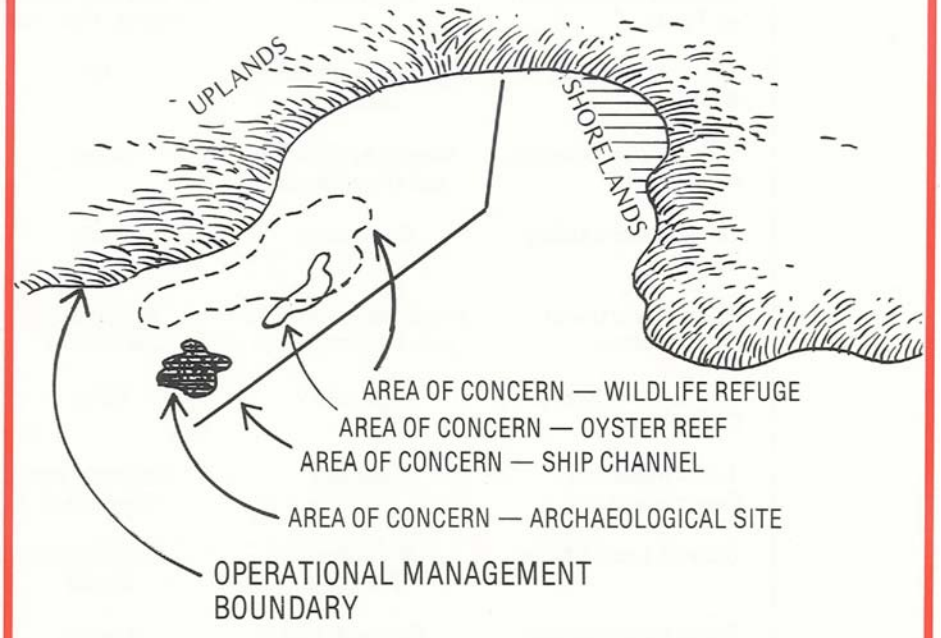
Governmental changes will be needed to improve coordination among management entities and increase the effectiveness of coastal management efforts. The changes recommended by the Coastal Management Program include transforming the Interagency Council on Natural Resources and the Environment into a policy-level advisory group, establishing a system for better information management, and implementing a systematic method for making permitting decisions. The proposed policy-level advisory group will, for convenience and for want of a better name, be referred to in subsequent discussion as the Natural Resources Council (NRC).

Creation of a Natural Resources Council

Transforming the ICNRE into a Natural Resources Council (NRC) to achieve more effective coastal management would bring about the needed coordination, require no constitutional changes, and cause only a minimal disruption of present activities. To assure effectiveness, the NRC should expire in four

Figure 23
OPERATIONAL MANAGEMENT BOUNDARY CONTAINING COASTAL WATERS AND SHORELANDS

provides conditions for "directness" of impact
contains "resource areas" basic to test of "significance"
contains areas of state concern – aiding permissibility test



years unless the legislature finds it sufficiently effective to warrant continuation.

The proposed changes in the ICNRE would make the NRC an executive council for reviewing and recommending coastal policy and programs to the governor and the legislature. It would not become a superagency, since its powers would be solely advisory.

How the Present ICNRE Should Be Transformed. A description of ICNRE agency responsibilities is shown in table 5, where the agencies are divided by primary functions: regulation, planning, or research and information. The table also shows which resources are addressed by each agency.

The present ICNRE cannot review or recommend policy. The executive directors of natural resource agencies are the designated representatives to the ICNRE from those agencies headed by boards or commissions, but the executive directors cannot coordinate coastal policy, since only agency board members and commissioners are empowered to decide policy issues for their respective agencies (fig. 24). The result is that

Table 5
MAIN FUNCTIONS OF ICNRE ENTITIES
IN THE COASTAL REGION

Agency	Major Functions	Major Coastal Concerns
Texas Parks and Wildlife Department	Regulatory; Planning; Research	Fish and Wildlife; Recreation
Texas State Soil and Water Conservation Board	Research and Information Dissemination	Soil; Agricultural Resources
Railroad Commission of Texas	Regulatory	Oil and Gas; Surface Mining; Pipelines
Texas Air Control Board	Regulatory; Planning; Research	Air
Texas Water Development Board	Research; Planning and Development	Water
Texas Water Quality Board	Regulatory	Water
Texas Department of Agriculture	Regulatory; Information Dissemination	Agricultural Resources
Texas Water Rights Commission	Regulatory	Water
Texas Industrial Commission	Planning	Industry and Commerce
General Land Office	Regulatory; Planning	State-owned Lands
Texas Forest Service	Research and Planning	Forests
State Department of Highways and Public Transportation	Planning and Development; Regulatory	Highways; Gulf Intracoastal Waterway
Bureau of Economic Geology	Research	Land Resources; Minerals; Natural Processes
Texas Department of Health Resources	Regulatory; Research Planning	Contaminated Shellfish
Texas A&M University	Research	Variable
Texas Historical Commission	Regulatory; Research	Historical/ Archaeological Sites
The University of Texas	Research	Variable
Governor's Office of State-Federal Relations	Coordination	Institutional Activities
Texas Coastal and Marine Council	Research and Information Dissemination	Variable
Governor's Budget and Planning Office	Chairs ICNRE Meetings and Provides Staff Support	Interagency Coordination of Planning

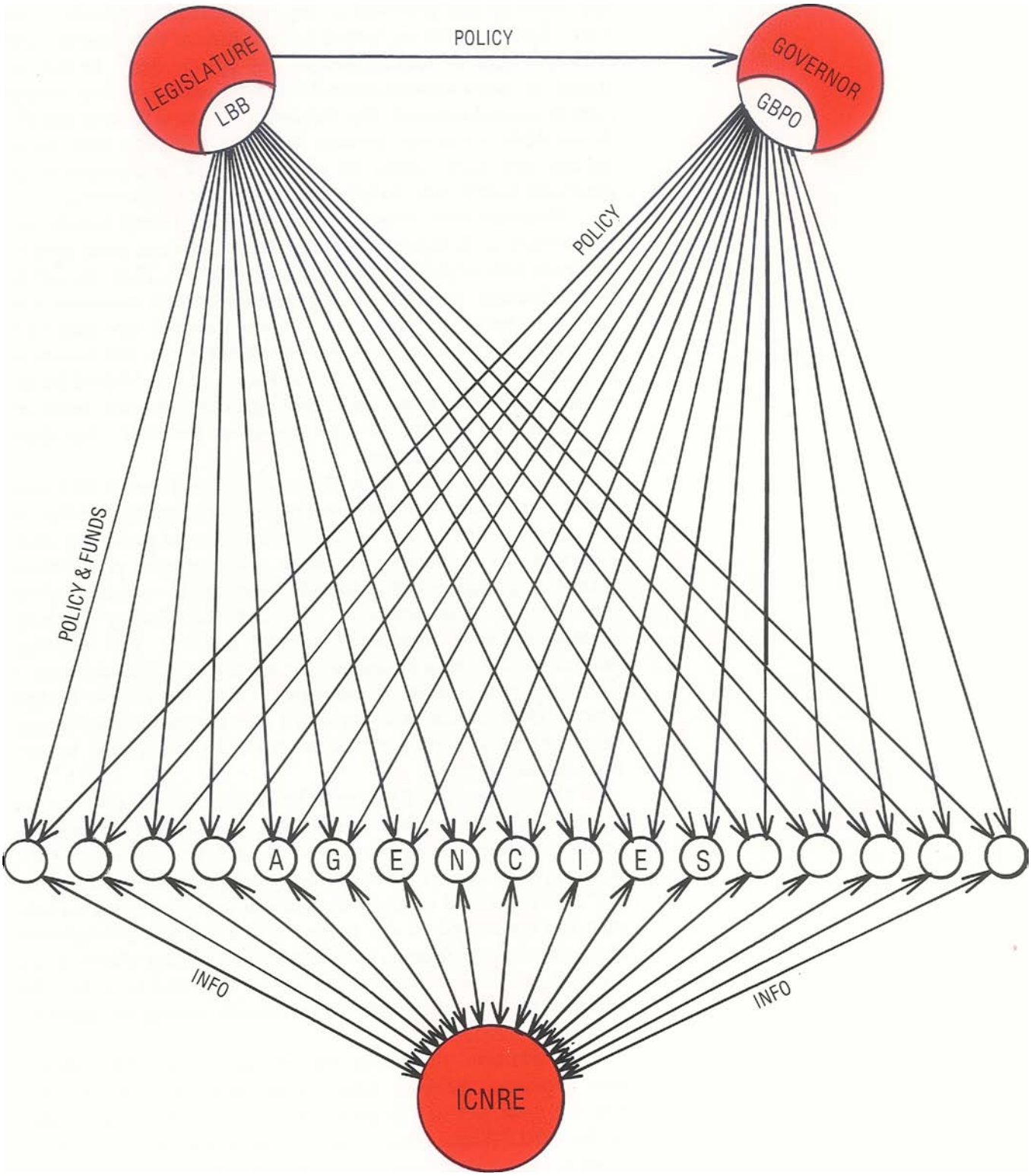


Figure 24
ICNRE FUNCTIONING PRIOR TO RESTRUCTURING

staff representatives attend in place of the executive directors, and the meetings are used only to exchange information.

To establish a body able to review and recommend policy on coastal matters, board or commission members should be appointed by the governor as the agency representatives to the NRC. Agencies with no formal boards, such as the General Land Office, would be represented by the agency head, in this instance, by the statewide elected official. Because of their unique roles in coastal research, the University of Texas System and the Texas A&M University System would be given full NRC membership and each would be represented by a member of its governing board selected for that purpose by the governor.

Problems arise, however, with the Texas Forest Service and the Bureau of Economic Geology. Each is a quasi-state agency, yet each falls within a university organization. They should be heard, because they represent important natural resources that are not otherwise represented. To avoid double representation or having representatives of nonequivalent levels, the Bureau of Economic Geology and the Texas Forest Service should be accorded nonvoting status. All other agencies presently members of the ICNRE would be represented on the NRC, but there would be notable additions.

The Governor's Energy Advisory Council should be a nonvoting participant because energy policy recommendations for the state are closely bound to coastal issues and problems. Nonvoting status is dictated by state constitutional prohibitions against assigning executive branch functions to members of another branch of government. The Governor's Energy Advisory Council includes legislative branch members. The attorney general should be included as a nonvoting member, since he is the chief legal officer of the state, and the Legislative Budget Board (LBB) should also be added as a nonvoting participant. Once again, nonvoting status for the LBB is required by the state constitution.

The proposed NRC would be chaired by the governor or by his full-time representative. This should further improve upon the effectiveness of the old ICNRE because even in the governor's absence a personal representative from the Governor's Office would monitor the council's work. Having a chairman not connected to any single state agency would emphasize the governor's position as *chief* fiscal and planning officer of the state. Also, such a chairman should be expected to reflect the governor's views as to the proper balance among the agencies' competing missions.

In addition to agency representatives, the NRC should have a citizens' advisory panel of no more than 15 members, and the chairman of this panel should be a nonvoting member of the NRC. These citizens should be appointed to staggered six-year terms by the governor. They should be chosen to represent a balance of economic, social, and environmental interests; and at least five should be drawn from coastal counties. The citizens' advisory panel should be provided staff services from

the small staff serving the NRC. This advisory panel should be empowered to hold public hearings from time to time, as appropriate, to air important issues. Participation by a citizens' group would perform three functions: it would give the members of the council added incentive to coordinate their policies, it would serve as a sounding board for the NRC, and it would increase the public accountability of the NRC.

NRC representatives should be selected from agency and university system boards and commissions because only board and commission members have the mandate to consider and set policies. Therefore, if a designated commission member could not attend an NRC meeting, only another commissioner should be allowed to substitute. In the event that NRC members who are also elected officials could not attend, they should be represented by their primary assistants. This would not exclude the working staff or executive heads of the member agencies from NRC deliberations. The close working relationship between the commission representatives and their respective agency heads and staff members would be enhanced as council members called for more detailed briefings on specific policy and program issues (fig. 25).

Commission and board members are citizens who work without pay and who may receive assistance from the staffs of the agencies they represent and from the very limited staff of the NRC itself. The NRC technical staff should be small and multidisciplinary to give its members access to experts in many fields. Both the full-time staff director and the NRC staff should be appointed by the governor.

The cost of maintaining this staff could be met in several ways, according to the preference of the legislature. One method would be to appropriate funds directly to the NRC. Federal funds under Section 306 of the Coastal Zone Management Act and Housing and Urban Development Section 701 Planning Grants would also be available to absorb part of the cost. The total cost should be only a fraction of the amount the state currently spends on coastal management and less than the price the state is currently paying for the ineffective efforts of the ICNRE.

General Functions of the Proposed NRC

Submission of Biennial Report. The NRC should be directed to submit biennially to the governor and legislature a comprehensive report on coastal problems and issues. This report should be issued in time to coincide with the preparation of agency budgets and should also be made available to the public. It should include the following:

1. A short description of the environmental, social, and economic changes that have occurred in the coastal region during the preceding two years. This description should include not only changes in physical systems and developmental patterns, but also changes in boundaries and in state or federal coastal policies.

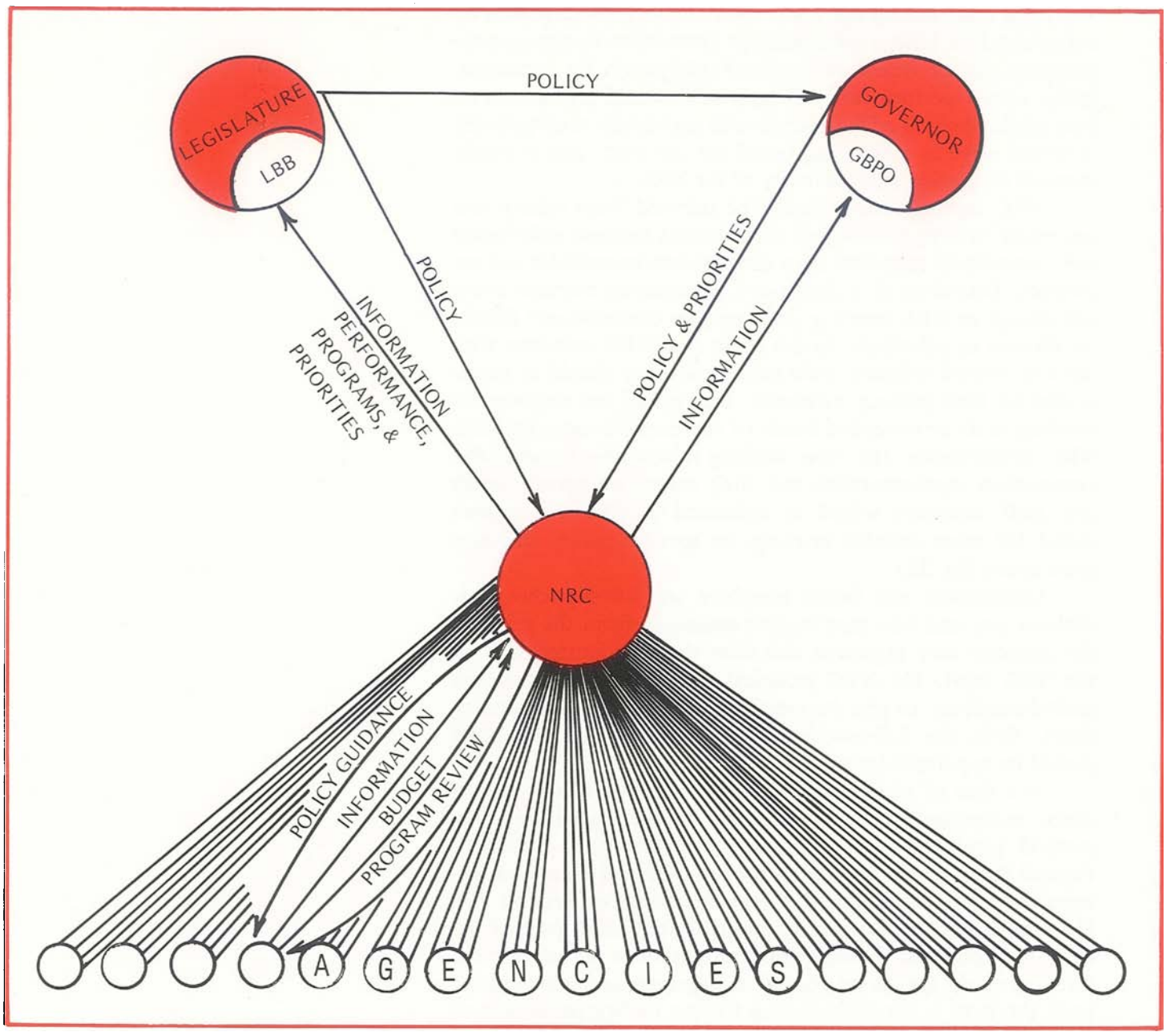


Figure 25
DIAGRAM OF FUNCTIONING OF PROPOSED NRC

2. A statement of the principal problems of state concern in the coastal area.
3. A statement of the steps recommended by the NRC to resolve the identified problems. This should include additions to or changes in state coastal policy and statutes, transfers of programs among agencies, and the creation of new programs or elimination of old ones.
4. A review of the effectiveness of current programs for implementing state coastal policy.

5. A report on the actions taken by the NRC during the biennium, including federal and state coordination, public hearings, administration of federal grant funds, and specific studies.
6. Recommended state coastal research priorities.

This report should be a candid and well-documented review since it will serve as the foundation for later NRC review and commentary upon state coastal programs.

Review of State Coastal Programs. The NRC should review and comment to the governor and legislature on all state coastal programs proposed in budget requests. The comments should note where recommended policies and priorities are being pursued. This would require agencies to describe their coastal programs separately from their other activities. State and university proposals for research funding should be given special attention in order to avoid duplication and to ensure that priorities are met. Compliance with state standards for data collection and accessibility (to be described below) should be a prerequisite for funding. If any part of a research project dealing with coastal resources is paid for with public funds, then the results of that research should be made public.

Establishment of Information Standards. The NRC should establish standards for information collection and storage, such as those used by the Texas Natural Resource Information System (TNRIS), to encourage sharing of data and cooperation in data-collecting efforts. The best information on economics and on natural and cultural resources should be made easily available to the agencies and the public.

As part of the state's data management program, the NRC should see that maps showing the boundaries of coastal waters and shorelands are updated regularly. Resource areas within coastal waters and shorelands should also be monitored, and changes in their boundaries or contents should be noted. Agencies should be encouraged to update their designated areas of particular concern.

Activity Assessment and Permit Evaluation. The available information could be applied to specific problems anywhere within the management boundary through an activity-assessment process. A process such as the one proposed by the Coastal Management Program should be formulated by the NRC and implemented by the Governor's Office and the agencies. This activity assessment by the agencies would be especially useful in assisting the state to fully evaluate permit applications, A-95 reviews, or other public activities in or near coastal waters (fig. 26). The activity-assessment process could improve management of wetlands by systematizing inquiry as to the costs and benefits of navigational improvements. The process would also aid the state in developing performance standards to maintain bay and estuarine productivity.

Maintenance of Federal Coordination. In order for Texas to harmonize federal activities occurring within or affecting its

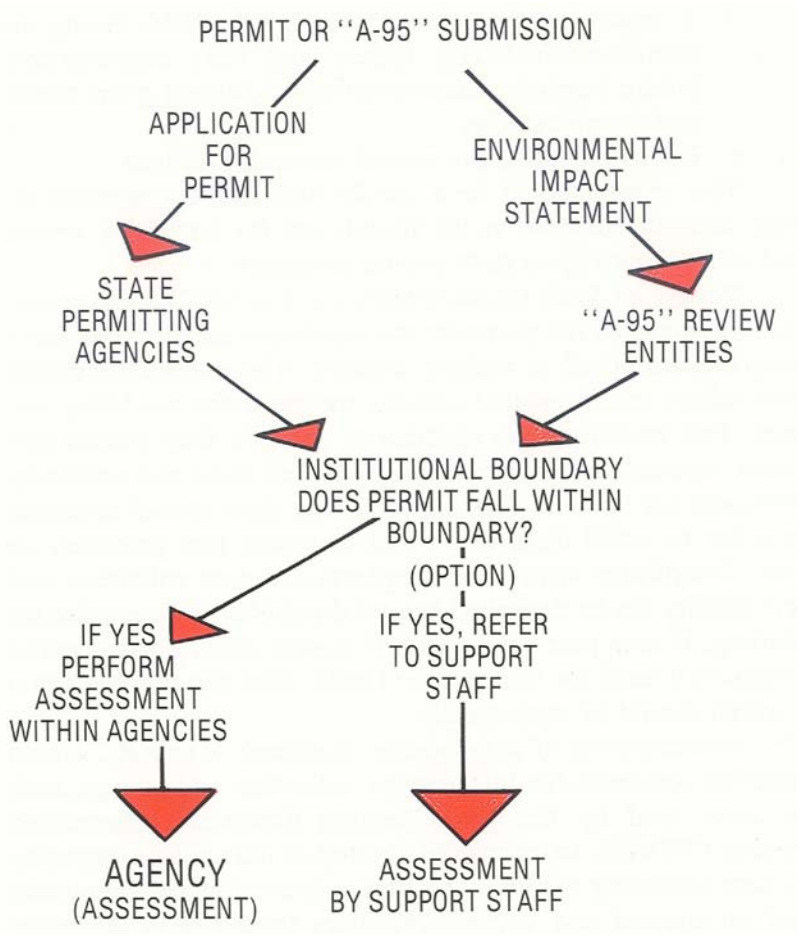


Figure 26
MECHANISM FOR BRINGING ACTIVITIES TO THE ATTENTION OF COASTAL MANAGEMENT REVIEW/ASSESSMENT PROCESS

coastal area, the state must coordinate its goals and policies with the national interest in the Texas coastal region. This will require identifying the current national interest, monitoring federal actions occurring within or affecting the Texas Gulf Coast, and making recommendations to the governor for the state's implementation of the federal consistency clause and the federal exclusion clause of the Coastal Zone Management Act.

Monitoring of State Coastal Planning and Research Efforts. The NRC must monitor the state planning and research programs which may affect the coastal management area. These would include the state's implementation plans for air and water quality, the coastal and marine research programs of the state's public colleges and universities, the coastal segment of the state's outdoor recreation plan, and others.

Conducting Hearings on Public Issues. The NRC is expected to hold public hearings on coastal policy issues to maintain the public participation that is essential to an accountable coastal management process. Appropriate topics for hearings in

even-numbered years include the budget requests of the state's agencies for coastal programs. In addition, the citizens' advisory panel may hold periodic hearings to provide additional local input into the state's coastal management activities. This would keep the advisory panel in close touch with local concerns.

Sponsoring Special Studies. The NRC will need to sponsor various special studies from time to time. For example, a study should be made of the freshwater inflows needed to maintain bay and estuarine productivity in time of drought.

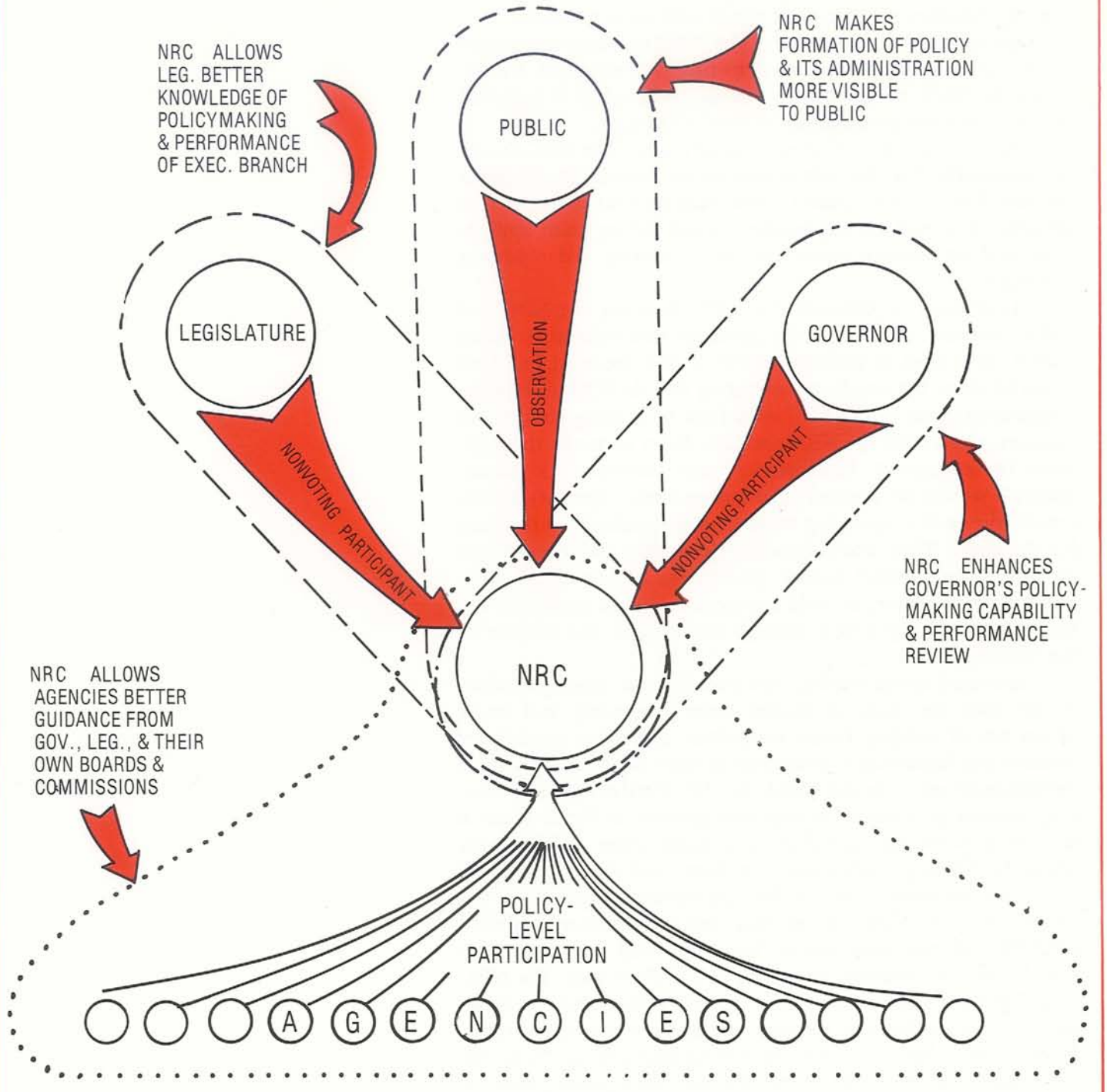
Administration of Federal Coastal Funds. The NRC should be responsible for the administration of federal grants under Section 306 of the Coastal Zone Management Act. In that capacity, it would be responsible for submitting grant applications and performing some routine accounting and reporting functions.

Advantages of Creating the NRC. Creating the NRC as a policy advisory council to the governor and legislature offers several advantages in addition to the readily apparent fact that it can be done by simply restructuring the old ICNRE. Recommendations made by the NRC would not be binding on member agencies, nor would the NRC preclude direct access to the legislature by any agency. In short, no "superauthority" or "superagency" would be created. The present state agencies would remain the state's operating research and regulatory authorities for the coast. They would remain independent and interact in a way that would ensure proper "checks and balances." All agencies would, however, be held accountable to the governor, the legislature, and the public through the reports and reviews of the NRC.

Increased accountability and coordination among agencies would help the state to budget more effectively and make better use of existing funds, manpower, and other capabilities because the legislature's awareness of state needs and program performance would be increased (fig. 27). Furthermore, because the essential problem of coastal management in Texas is not a lack of policies, but a failure to support those policies with adequate funding, performance reviews, and coordinating efforts, the proposed NRC is the appropriate response to the Texas situation. Other states may lack information, policies, programs, or personnel, but in Texas the need is to assure the appropriate ties between budgeting and performance. The NRC would give the Governor's Office a better opportunity to shape agency programs because the governor could send proposed programs to the council prior to agency budget-writing. Thus, the council would ensure more effective executive participation in the administration of state policy and more effective executive and legislative review.

The creation of the NRC would also make the data and expertise of the state's natural resource agencies available to all other state agencies, the executive branch, the legislature, and

Figure 27
HOW NRC IMPROVES ACCOUNTABILITY



NRC IMPROVES ACCOUNTABILITY:
ALLOWS GOVERNOR, LEGISLATURE, PUBLIC, & AGENCIES
TO PERFORM THEIR ROLES MORE EFFECTIVELY

the public. These changes should not cost more money, although they would demand the time and energies of public-spirited citizens—both board and commission members and the citizens' advisory panel members. In addition to better management without higher costs, these changes would increase public participation in agency policymaking.

Information Systems

Overall State Information Needs

Accurate, up-to-date information is essential for making better decisions. This is especially true for decisions affecting the ever-changing coastal region. Data on coastal waters and shorelands must be continually revised and supplemented. This involves efforts by experts in many fields. If data collection is to be directed to the most important problems, then there must be coordination among data-collecting entities. The NRC should provide the necessary coordination.

Funding important research is not enough, however; there must be means for data storage, evaluation, and retrieval. These data must be made readily available to decision-makers. This could be accomplished through a central state data system such as that now housed in the TNRIS. The data system could be connected with operational systems in agencies, universities, and elsewhere. To do this, a compatible format for all coastal data bases would be required. A data coordinator (such as the TNRIS) responsible to the governor should be able to recommend the necessary changes in any system that uses state funds. The data coordinator should be responsible to the governor rather than to any single agency in order to facilitate cooperation and coordination among agencies.

Through the data coordinator, the NRC should propose guidelines for electronic storage and retrieval systems, standardized field methods for data collection, and standardized maps. The guidelines should also encourage application of new technology as it becomes available.

Needs That Should Be Addressed by the Information System

The NRC should identify specific data needs through the evaluation of existing data and research programs; however, some general needs that should be addressed by any information system adopted by the state are already evident. The activity-assessment routine should reveal further gaps in basic information.

Economic Data and External Values.

One information need is the ongoing refinement of coastal economic data. This could be accomplished through updating of the state's input-output model—especially data on coastal sectors sustained directly or indirectly by coastal waters. Additional attention should be given to noneconomic values of the coastal region, such as clean air and water, the natural systems

that benefit the general public, aesthetic features, and other social values.

Composite Resource Areas.

Continuous testing, checking, and refinement of resource area descriptions is needed. This would involve the updating of both the mapped boundaries of these areas and their characteristics. Maps at a scale of at least 1:24,000 should be used to monitor these areas. Mapped features should include topography or bathymetry, substrate, soils, and biota. These features are used to define resource area boundaries, but data on the water chemistry, probable natural energy flows, and material flows must be used to confirm the map information. Whenever practical, the data collected should be put into a format that will allow them to be encoded into a computer. The data format should conform to data storage and retrieval standards recommended by the NRC and set by the governor.

Information about the characteristics, products, and connections among the various areas can be presented in a series of ecological "systems diagrams" for each of the resource areas. These systems diagrams serve as expanded definitions of each of the resource areas. They show the important characteristics of resource areas and links between natural resources and human activities. The systems diagrams allow a user of coastal resources to recognize and allow for these critical points. By examining a systems diagram, a resource user or a reviewer of permit applications can determine which features of a resource area would be altered by a given activity; for coastal waters, these features include salinity, sediment, nutrients, and biota. In this way, he can distinguish the activities likely to have serious effects on a given area from those that would have insignificant effects.

Social Values.

Very little information about social values is currently available. Almost no standards exist for gauging social or psychological preferences and general public well-being, yet both affect livability. More information about these values—and perhaps a means of assessing them—is needed, because they should be taken into account when decisions are made.

Development of Probable Cause-and-Effect Chains for Projected Activities.

A listing should be made of the elements that make up the "causal chains" linking economic sectors to their ingredient activities, activities to their effects on natural systems, and altered natural systems to their effects on economic systems or the environment. These chains include economic sectors that depend on or use coastal waters, activities that may be generated by the various sectors, environmental changes associated with coastal activities, ecologic characteristics by which environmental changes may be measured, and effects of the various alterations on the environment and economic or other human activities. Specific relationships can be assessed for any specific location and activity.

Evaluation of Boundaries.

One of the most important tasks in improving information flow and coordination is keeping the boundaries of coastal waters up-to-date. This is a technical problem that demands monitoring of changes in coastal waters boundaries, as well as in the contents of the resource areas that comprise coastal waters and adjoining shorelands.

Communication Among Users of Information.

An important part of the information system will be the sharing of data among the state agencies, from one level of government to another, and between the agencies and the private sector. Coastal resource information should be written in nontechnical language and distributed to the public.

Much of the suggested structure for the information system has already been designed as part of the TNRIS, which was developed by the Natural Resources Information System Task Force under the authority of the ICNRE. The TNRIS is operational on a limited scale and has still not been fully implemented, but there are already plans for joining current state information systems. The TNRIS has considered standardized formats; data base requirements; map base data; information quality and standardization of measurement, presentation and dissemination of information; duplication of collection and storage; and hardware and software compatibility. Only minor additions would be needed for the TNRIS to develop into the information system required for efficient coastal management.

To respond more effectively to the needs of all, however, the TNRIS should be independent of any existing state agency. This would avoid bias. The ICNRE support staff in the Governor's Office could use the information system to monitor and update the boundaries of coastal waters and the closely associated shorelands, the boundaries and characteristics of composite resource areas, and the designation of areas of particular state concern within the management boundary.

Activity-Assessment Routine

The activity-assessment routine is a systematic means for considering coastal natural, economic, and social systems as a whole. It is an approach that uses the best available information on all the economic, social, political, and environmental consequences that might result from any proposed activity on the coast. It is designed to aid decision-making by state agencies responsible for coastal permitting and project review functions. It would not give final answers, but it would organize the process by which decisions are reached so that a full accounting of the facts and reasons underlying a decision could be given to any interested person.

The activity-assessment routine is built on several assumptions. One is that the program's main concern is coastal waters and shorelands. Second, it is assumed that the state will coordinate support functions for coastal management through the

NRC. These functions are boundary mapping, updating information about resource areas, and monitoring coastal activities. Third, it is assumed that present permitting mechanisms within the state or federal agencies are sufficient to reach all activities that may have a direct and significant impact on coastal waters. Given these assumptions, a step-by-step management process can be described.

Assessment of coastal activities would be done by the permitting and reviewing agencies of the state. The assessment process would be applied only to activities affecting the coastal waters and associated shorelands, the established management area.

Permit applications and A-95 applications would be reviewed to see whether the proposed activity was inside the management boundary. Permit applications for a proposed activity within the 18 coastal counties would be examined to see if the activity would be located within the coastal waters or shorelands. If the proposed activity would fall within the mapped management boundaries, then it would be deemed an activity that *directly* affects coastal waters.

Other proposed activites, those *not* directly impacting the waters and shorelands, would not be considered; assessment of these impacts is beyond the scope of the coastal program. Many of these areas—including flood-prone areas, subsidence districts, water districts, and areas of state or federal ownership—are covered by other state and federal authorities. These areas are shown on maps of particular state concerns and on maps of federally controlled lands.

An activity judged to "directly" impact coastal waters would then be checked for "significance." The determination of significance depends on a detailed knowledge of the location of the proposed activity, the activity itself, and the resource areas of coastal waters or shorelands affected by the activity. Evaluation of both directness and significance will depend on the amount and quality of data in the information system; a decision must be made with the information that is available.

The activity—once it is located on a map showing the boundaries of coastal waters and shorelands and the affected resource areas—must be adequately described. The design of the proposed activity could be compared to the detailed maps showing bathymetry, topography, substrate, and biota to qualitatively predict the most direct effects of the activity. Information on chemical or physical conditions must also be considered.

Each resource area has characteristic requirements that must be met if the resource area is to be maintained. If a proposed activity in a resource area would change the environment so that one or more of these requirements were not met, the proposed activity would be deemed "significant." This determination of "significance" should be based on the best technical information available. "Significance" does not rule out an activity, it just means that the activity should be examined

closely. If an activity were not deemed "significant," then it would be treated like a noncoastal activity and the assessment process would stop.

The proposed activity-assessment routine would present public and private decision-makers with the probable effects of a proposed activity. These would include environmental alterations as well as economic impacts and effects on social values. In addition to effects, the routine would point out changes that could be made in the activity to reduce disturbance of specific resource areas. The routine would provide information showing the major results of an activity in both dollar costs and in social and environmental costs. No activity would be automatically rejected by this process, and suggested improvements in a proposed activity could be accepted or rejected. The routine is designed to provide those who make the decisions with the best estimate of the probable effects.

At the request of an agency, the TNRIS would provide the information for the agency to use the assessment routine or, if an agency preferred, the Governor's Office would provide questions based on the assessment method and assist the agency in using it.

Permitting procedures would not be changed by the use of the activity-assessment routine. The permitting agencies would decide whether or not to allow an activity, as is the case under the present system. This is not the job of the NRC or of the Governor's Office. Figures 28 through 30 show the relationships

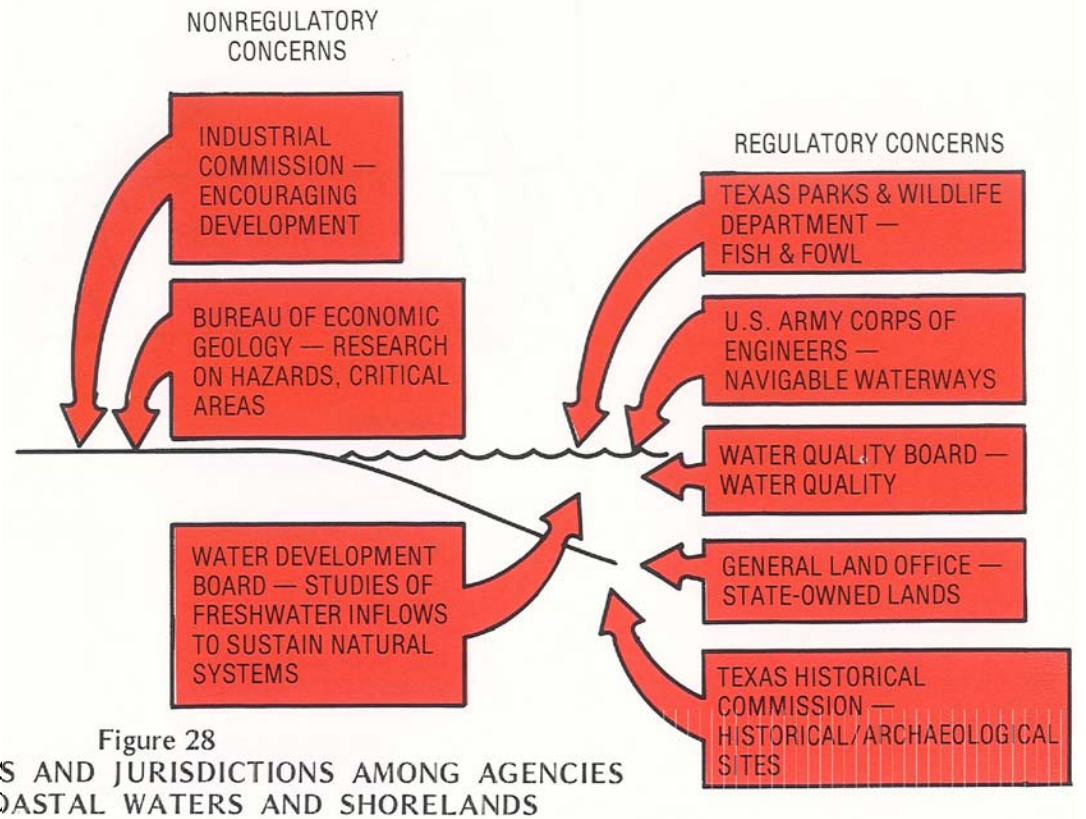
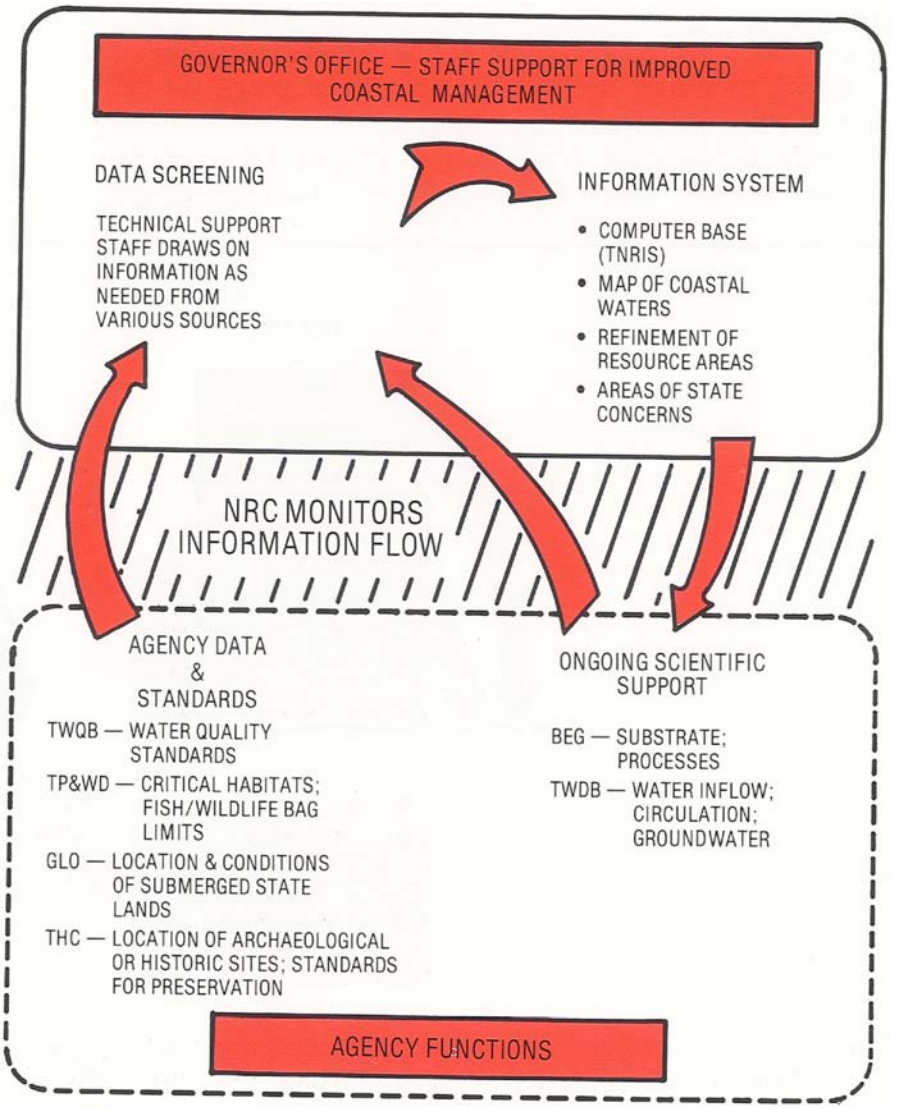


Figure 28
SELECTED INTERESTS AND JURISDICTIONS AMONG AGENCIES REGARDING COASTAL WATERS AND SHORELANDS

among the NRC, state agencies, other public regulatory research or planning authorities, the applicants, and the public. These diagrams show both the information flow and the activity-assessment routine. Figure 28 shows some types of concerns and jurisdictions on coastal waters and shorelands. Figure 29 shows how regulatory and research agencies would exchange information with the Governor's Office. Figure 30 illustrates how the Governor's Office could use the information system and assessment routine to prepare questions and provide information about the proposed activity to the state agencies. This diagram also shows how information would be transmitted from the applicant to the reviewers within the permitting agencies.

Figure 29
INFORMATION SYSTEM—EXAMPLES



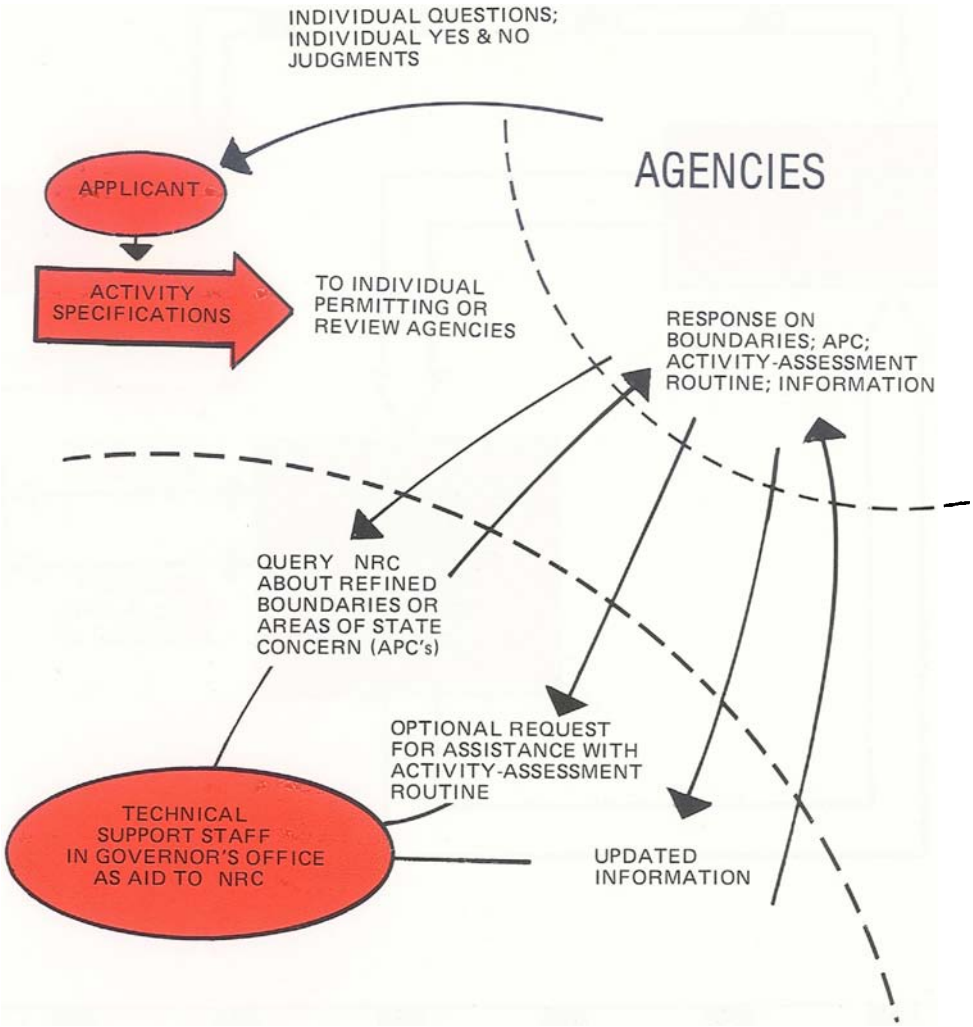


Figure 30
INTERACTIONS AMONG THE AGENCIES, THE NRC, AND THE PROPONENT OF ACTIVITIES

Figure 31 is a simplified diagram that shows how the Governor's Office could aid the agencies in evaluating permits. Various parts of the permitting diagram (fig. 31) relate to different aspects of coastal management. One of these is the present relationship between an applicant and a permitting agency. This relationship includes all stages of the permitting process, from application to the granting or denial of permits by agencies. Another part of the diagram shows the function of providing questions and information through the Governor's Office. Other parts show the information system that would be maintained by the Governor's Office and the TNRIS and the relationship between the NRC and the general public. Figure 32 depicts the flow of information among the Governor's Office, the public, federal and state agencies, and proponents of

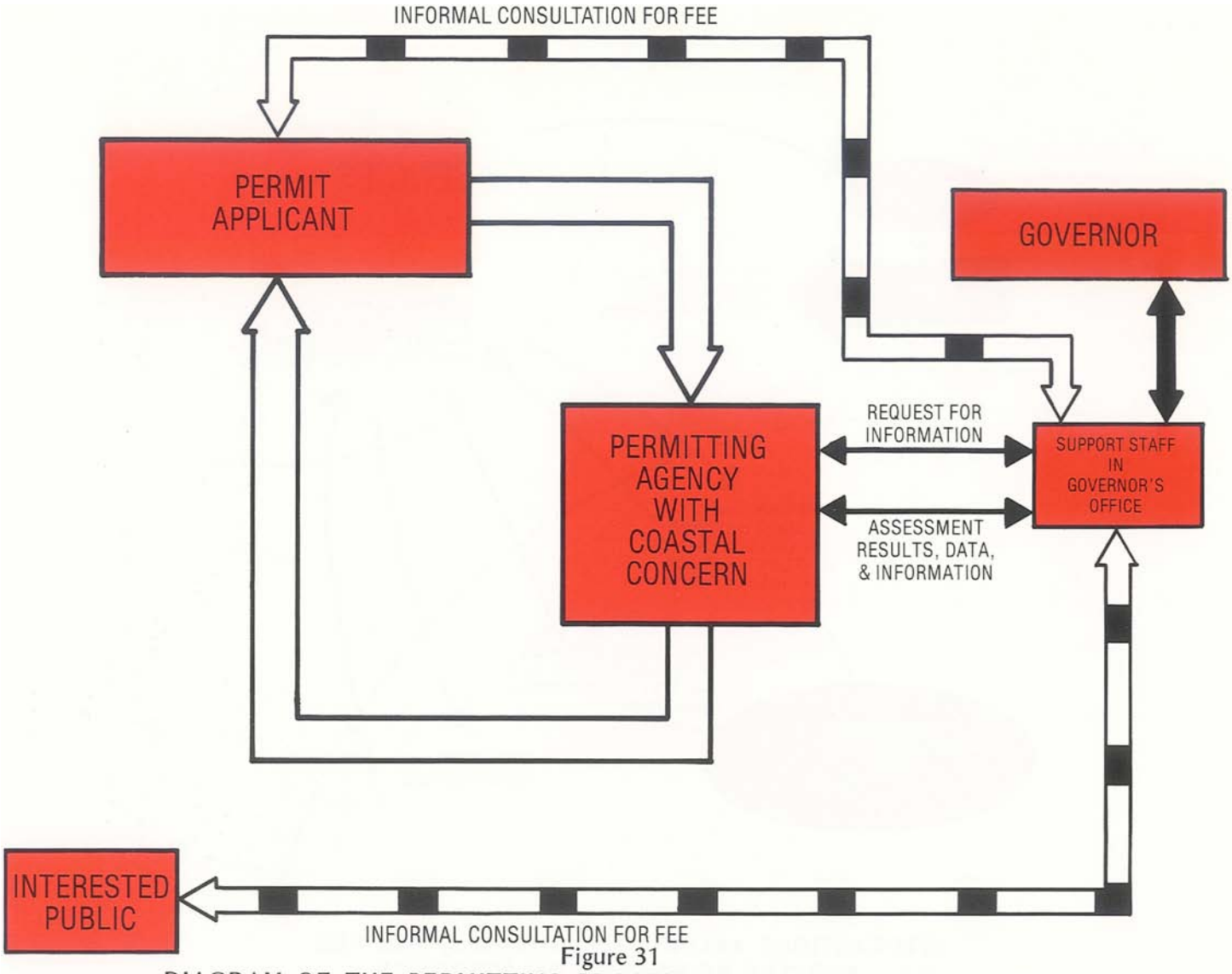


Figure 31
DIAGRAM OF THE PERMITTING PROCESS ILLUSTRATING USE OF THE PROPOSED ACTIVITY-ASSESSMENT ROUTINE

activities that require A-95 review. The review process is similar to the permitting process shown in figure 31.

Other Recommendations

Hazards

To reduce property losses from coastal hazards, the Coastal Management Program recommends that buyers and owners of property subject to these hazards be warned of the risks involved. For this purpose, it is recommended that the Bureau of Economic Geology (BEG) be directed to prepare and maintain large-scale coastal hazard maps depicting the areas in which these processes may be active. The NRC should recommend means by which this information can be best supplied to

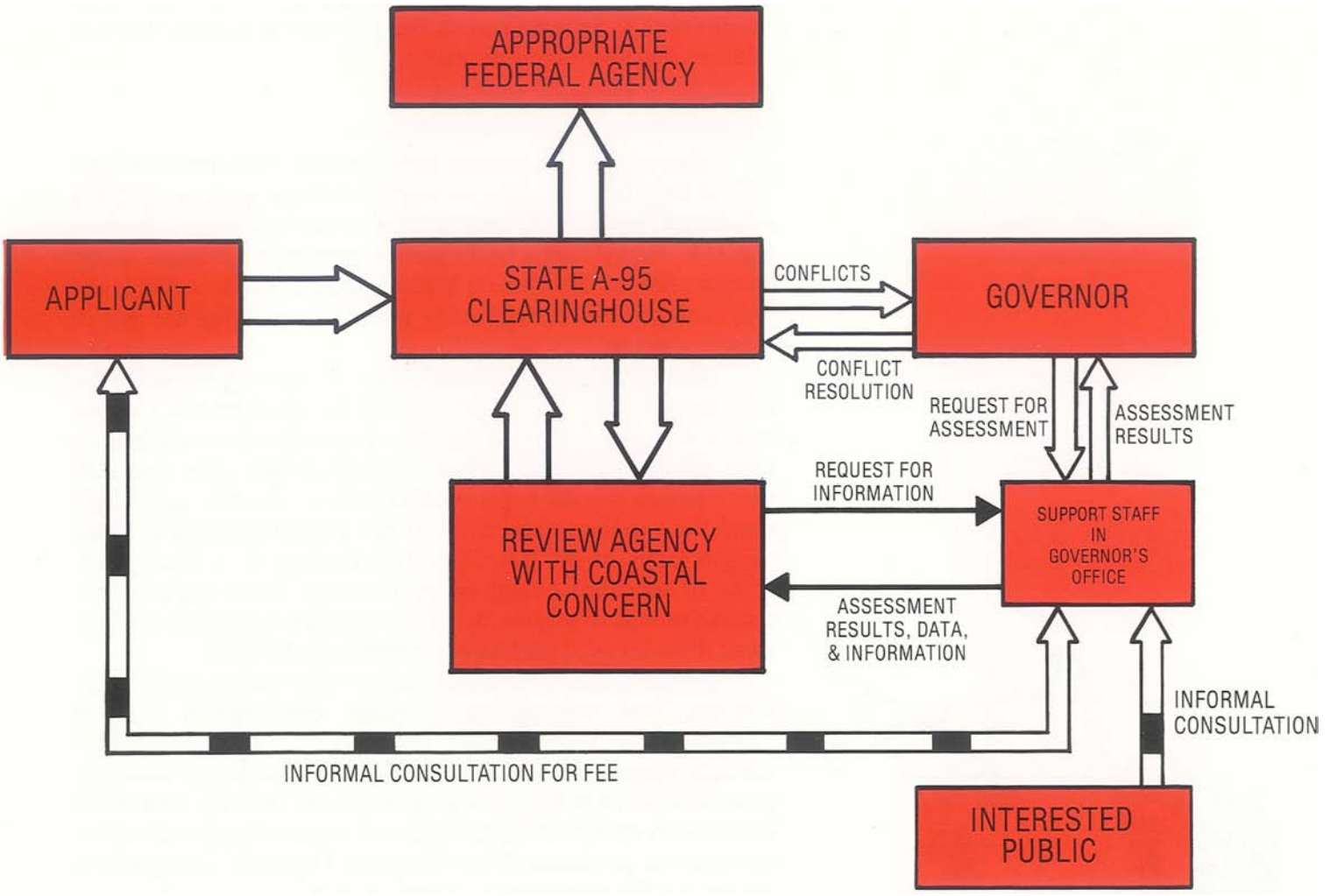


Figure 32
DIAGRAM OF THE A-95 REVIEW PROCESS USING THE PROPOSED ACTIVITY-ASSESSMENT ROUTINE

buyers and owners. Warnings about erosion rates and storm hazards might be written into deeds to property located in hazardous areas. Further reduction of storm hazards could be achieved by continuing present "hurricane awareness" programs to warn coastal residents of the nature of these storms and how to prepare for them. These recommendations should be presented to the governor and the legislature. Monitoring of these hazards should also continue.

The NRC should use BEG maps to determine whether additional protection for active dunes on the Gulf shoreline is needed and, if so, recommend how this should be accomplished.

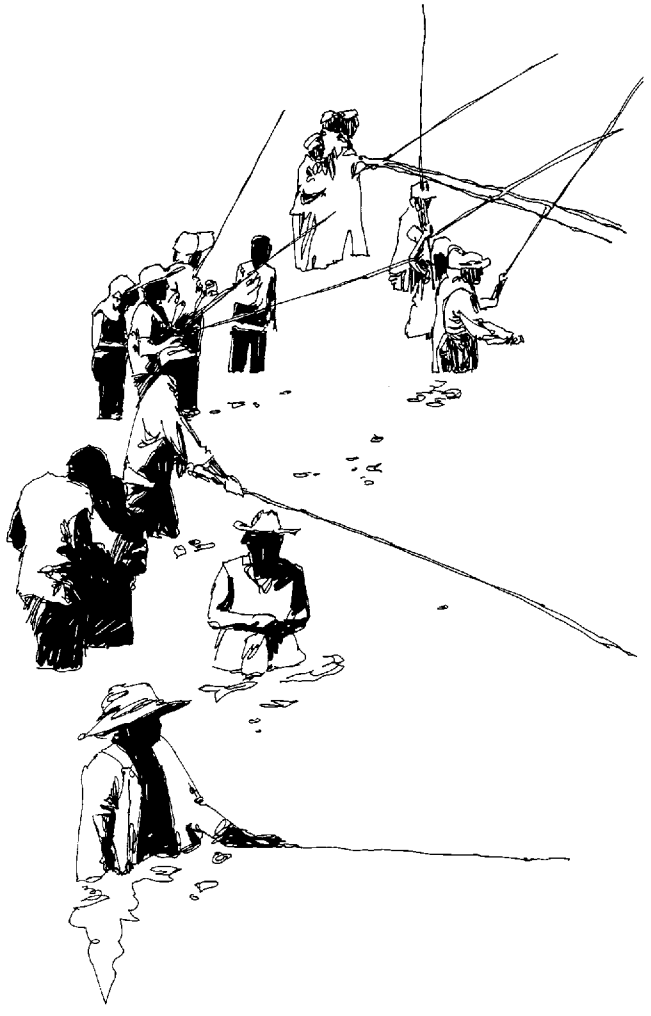
Information distribution alone, however, is an insufficient means for addressing the problem of subsidence, which should be paid careful attention by the NRC. The legislature recently

studied subsidence and created the Harris-Galveston Coastal Subsidence District to respond to the problem. The NRC should be directed to recommend to the governor and legislature any additional action that is needed.

Activities in Saltwater Wetlands, Coastal Waters, and Submerged Lands

Although at the present time the state exercises some control of activities occurring in coastal wetland areas or upon the submerged lands of the state through state regulatory processes, the U.S. Army Corps of Engineers regulatory program under Section 404 of the Federal Water Pollution Control Act is the only comprehensive regulatory program regulating the use of these resources.

The state's present broad policy concerning wetlands and submerged lands should be clarified by restatement, and the state's activities and programs affecting wetlands should be pursued vigorously and with better coordination. This improved coordination should begin with efforts to identify and understand the varying productivity of the coastal wetlands and submerged lands of the state. Based on findings as to the productivity of specific wetland areas, the state should make a concerted attempt to acquire by gift or purchase for public management those areas of critically important productivity.



These state efforts toward better information, policy clarification, and interagency program coordination will be augmented by implementing the foregoing recommendations for data management, activity assessment, and policy-level program review. Better data management and activity assessment should also enable the state's agencies to participate more effectively in the processes of the Corps of Engineers for regulating dredge and fill operations in coastal waters.

Present Corps processes for deciding dredge and fill permit applications have been criticized as too protracted and not sufficiently focused upon the relevant issues. To expedite, to rationalize, and to bring under more local control the processes affecting dredge and fill operations in coastal waters, the state should be prepared to assume primary responsibility for regulating dredge or fill activities which occur in coastal waters but which are not conducted by or under contract to the Corps. State wetlands regulation should not be undertaken unless it can be done in place of the Corps' wetlands regulation activities under Section 404 of the Federal Water Pollution Control Amendments. This means that a delegation of Corps responsibility is desirable and should be sought under both the Coastal Zone Management Act and any other relevant federal legislation. To assure state preparedness, appropriate state statutory authority vesting regulatory responsibility in a specified agency should be enacted. The statute should be written, however, so that commencement of regulation awaits the governor's determination that the relevant responsibilities of the Corps can be delegated to the state.

Bay and Estuarine Productivity

To be biologically productive, bays and estuaries require fresh water, sediment, and nutrients. The exact amount and timing of freshwater, sediment, and nutrient inflows necessary for the highest bay and estuarine productivity are not known, and studies long underway may not provide final answers.

The NRC should be directed to recommend to the governor appropriate performance standards and methods to ensure the delivery of adequate amounts of fresh water, nutrients, and sediments to the bays and estuaries. The inflow standards should be determined on the basis of the available data about the requirements of these areas. They should also take the water needs of upland areas into account and should be modified in response to better information and changing circumstances.

Federal Coordination

It is recommended that the state obtain federal approval of its Coastal Management Program. If the program is approved, the state can require that federal activities in or affecting the coastal area conform to the state's program "to the maximum extent practicable." To be approved, a state program must include a method for considering the national interest in its coastal resources and for protecting that interest. To meet these requirements, it is recommended that the following actions be taken:

1. The NRC should be directed to maintain proper coordination with all interested federal agencies through the Governor's Office of State-Federal Relations and the Federal Regional Council.
2. All agencies should be directed to give full and fair consideration to the national interest in their deliberations on coastal resources.
3. The NRC should monitor all federal actions that may affect the Texas coast to ensure their consistency with the state programs.
4. Disagreements between federal agencies and state agencies regarding coastal management issues in Texas should be resolved among the interested agencies. Failing this, the governor should decide the matter for the state. A dissatisfied federal agency could then appeal the matter to the Department of Commerce and pursue it further according to controlling federal regulations.

In the event that a local government arbitrarily restricts or excludes facilities or activities of national interest or of greater than local benefit, an aggrieved party should be awarded prompt judicial review. Judicial review (rather than administrative review) is proposed since administrative remedies would probably prove inconclusive.

How the Proposed Process Meets General Policy Objectives

The proposed coastal management process includes restructuring the old ICNRE to create a Natural Resources Council (NRC), establishing a coastal management boundary, instituting an information system, and formalizing an orderly process for assessing the economic, social, and environmental consequences of coastal activities (fig. 33). It satisfies the stated general policy objectives and lays a foundation for solving many of the state's coastal problems.

1. The proposed management process focuses on ongoing coastal problems through the NRC, which is charged with maintaining an overview of these problems and recommending policies to aid in solving them.

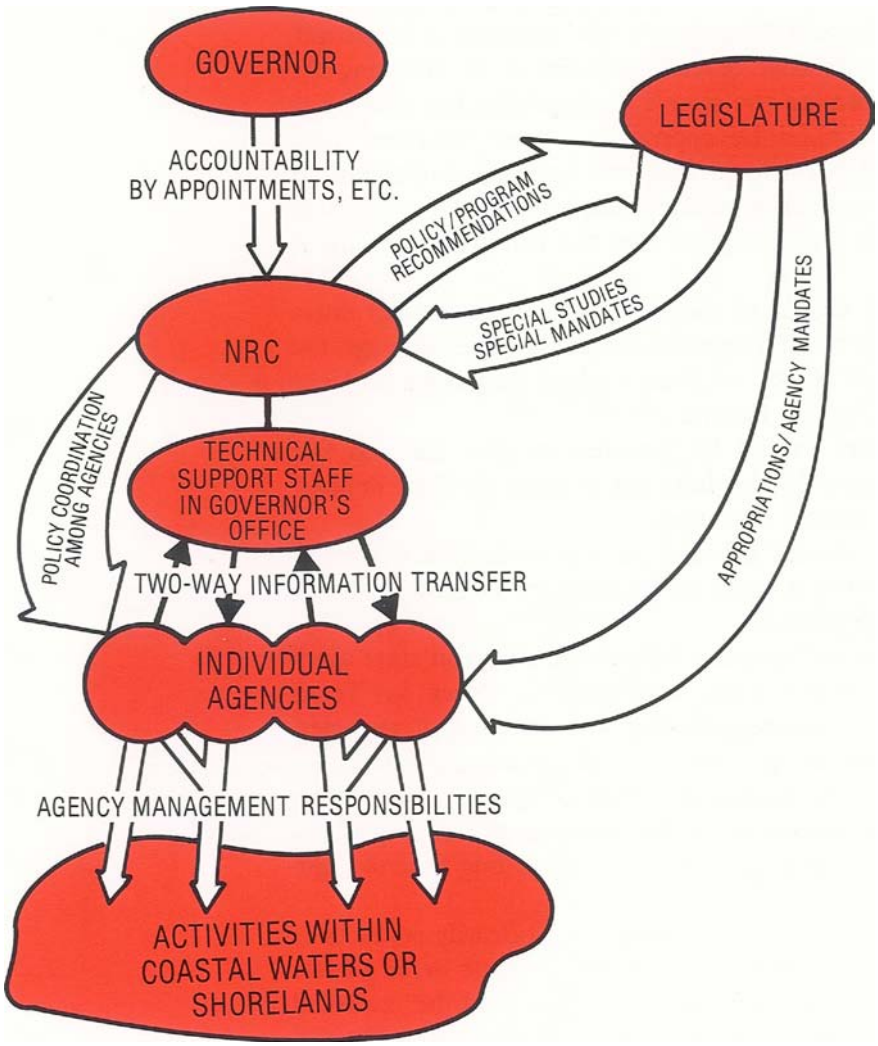


Figure 33
TOTAL WORKING OF COASTAL MANAGEMENT PROGRAM

2. The NRC and the agencies' use of an activity-assessment routine would ensure balanced consideration of demands for both intensive development and preservation.
3. By restructuring the ICNRE to create the NRC the program would make use of existing authority.
4. Coordination within state government and communication between state and federal agencies would be improved through the proposed reformed institutional arrangements.
5. General policy priorities for coastal resources would be reviewed and recommended by the NRC. The consequences of these priorities for specific areas would be determined by the agencies using an activity-assessment routine.
6. The policy overview provided by the NRC and the agencies' use of the assessment routine should promote fair decisions.
7. The assessment routine would keep the proposed management process flexible and increase the predictability of government actions.
8. Overriding state and national concerns would be identified and updated by the coordination and communication inherent in the NRC. These concerns would be communicated by the information system.
9. Accountability to the public would be gained partly through the increased communication of state coastal policies and programs. The presence of citizens on the NRC—both as agency board members and as nonvoting advisory committee members—should increase this accountability.
10. Public comment on coastal problems would be received both through the regular proceedings of the NRC and through public hearings on the most important issues.
11. The proposed coastal management process need not impose new costs on government or the taxpayer or impose new regulations on private property, and it would make the application of present regulations more impartial.
12. The proposed program satisfies the requirements of the federal Coastal Zone Management Act yet is designed to deal with Texas' problems.

Summary of Recommendations

To achieve an orderly process for managing coastal resources, the following changes are recommended:

1. Draw the boundaries of the coastal management area to
   a. include all coastal waters to the three-league limit—nearshore Gulf areas, inlets and tidal deltas, bays, lagoons, oyster reefs, grassflats, spoil deposits, channels, coastal lakes, tidal streams, and river mouths up to the farthest point of seawater intrusion;
   b. include all beaches, barrier islands, spoil islands, wind-tidal flats, tidal marshes, washover areas, and sand dune complexes on the Gulf shoreline; and
   c. exclude lands held under the exclusive control of the federal government.
2. Convert the Interagency Council on Natural Resources and the Environment (ICNRE) into a Natural Resources Council (NRC) which would function as a policy-level council to review and propose policies, priorities, and activities for the state's coastal program. This requires the following steps:
   a. Each agency presently represented on the ICNRE should be represented by a member of the agency's board or commission as the voting member. Executive directors would attend, but as nonvoting members.
   b. Include one representative each from the Governor's Energy Advisory Council, the Attorney General's Office, and the Legislative Budget Board as nonvoting members of the NRC.
   c. Create a 15-member, gubernatorially appointed citizens' advisory committee for the NRC, with a chairman who is a nonvoting member of the council.
3. Establish in the Governor's Office a practical process for systematic assessment of the environmental, social, and economic consequences of proposed coastal activities. A state data management system based on existing systems should be structured to focus research on priority state needs and to provide data for the assessment routine and thereby assist state decision-making. Results derived from application of the activity-assessment routine and any information housed in the state data management system should be made readily accessible both to governmental entities and to the general public.

4. Direct all state regulatory agencies to use either the activity-assessment process developed for the Governor's Office or a similar process to assess environmental, social, and economic effects in reviewing all permit applications for proposed activities within the management boundary.

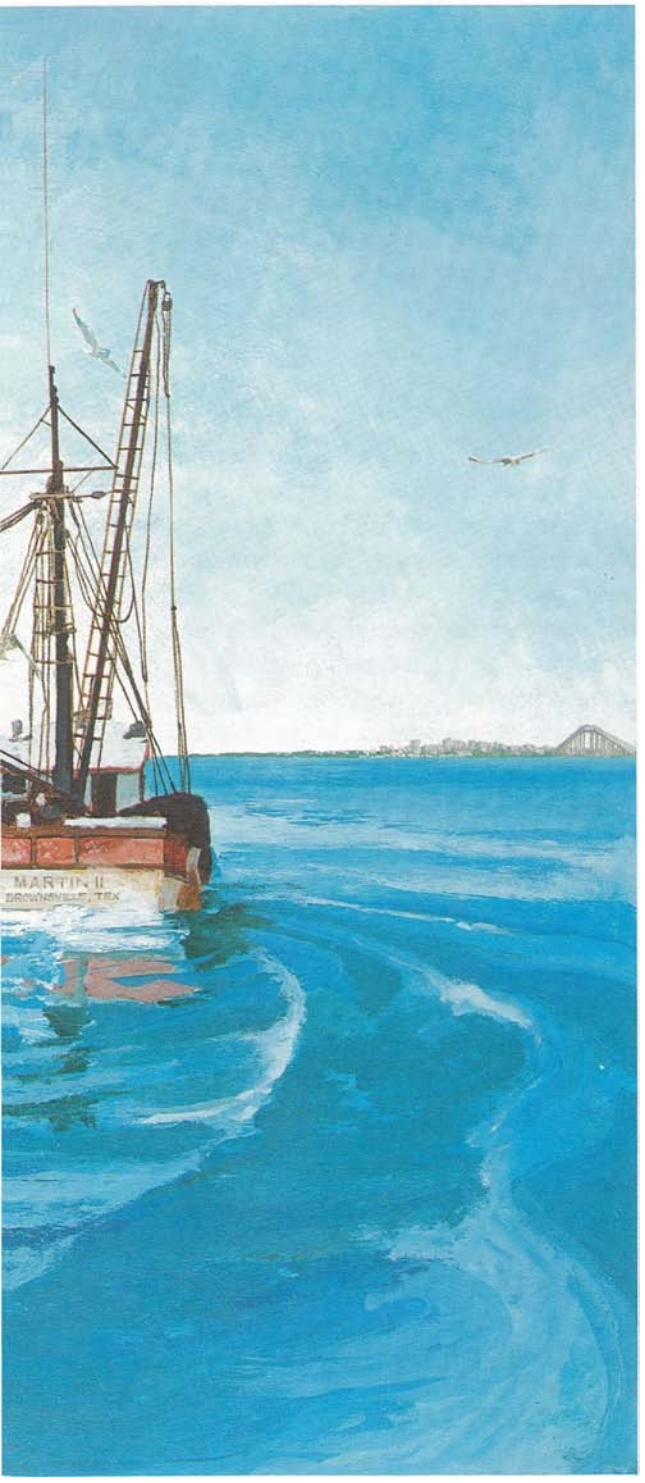
5. A three-part response should be made to the problems posed by coastal hazards.
   a. Direct the NRC to determine how best to give notice of coastal hazards to purchasers and owners of coastal property.
   b. Direct the NRC to determine whether additional protection for coastal dune areas is needed, and, if so, how to accomplish it in a manner consistent with the protection of private property rights.
   c. Direct the NRC to review the state's efforts toward solving the subsidence problem and determine whether further action is needed.

6. Coordinate and clarify state wetlands policy; and, if the wetlands regulation program of the Corps of Engineers can be delegated to the state, establish a state wetlands regulation program to cover all dredge and fill activities in coastal waters except large navigational projects, such as those conducted by the Corps. Avoid duplication of the Corps of Engineers permitting processes.

7. Direct the NRC to recommend to the governor, on the basis of existing information, the freshwater, sediment, and nutrient standards which should be assured for the state's bays and estuaries. In addition, direct the NRC to recommend to the governor methods to assure proper distribution of water for upland and coastal needs in times of drought.

8. Direct all agencies to consider the national interest in exercising their powers, and direct the NRC to monitor federal actions on the coast for consistency with the state's coastal program. If disputes between federal and state agencies in coastal matters cannot be resolved by the parties, the governor should determine the state's position. After his decision, an interested federal agency could pursue the matter further according to applicable federal regulations.

CHAPTER V
ADVANTAGES OF THE PROPOSED MANAGEMENT PROGRAM



OVERVIEW

The proposed coastal management program discussed in detail in Chapter IV offers four principal benefits to all coastal residents:

1. the preservation of state responsibility over coastal policy against potential federal intrusion,
2. increased accountability of state agencies for their activities on the coast,
3. increased efficiency in state coastal programs, and
4. practicality.

The proposed program would focus the coastal management efforts of state agencies on problems of concern to the full range of coastal interest groups without increasing current regulatory authority. Where government can improve a situation, the proposed program supplies a mechanism for the agencies to use in analyzing and solving coastal problems.

The recommendations made in this document may, like any proposals for change, have potential drawbacks which should be carefully analyzed. However, preliminary analysis shows that the advantages of the proposed program far outweigh the disadvantages. The costs involved in restructuring the ICNRE to establish the NRC, implementing the activity-assessment routine, and assuming the Corps of Engineers' jurisdiction over saltwater wetlands would be mitigated by direct savings to the state and private sectors and by some federal funding. Costs would be further reduced by increased interagency cooperation.

ADVANTAGES

Preservation of State Control of Coastal Policy

The federal government, through the Coastal Zone Management Act, offers the State of Texas the opportunity to

—regain some authority presently delegated to the federal government,

—require federal activities on the coast to conform to state coastal policy, and

—prevent imposition of any federal coastal plan.

An approved state coastal management program may preempt imposition of a federal program. Were Texas not to act, and the federal government to decide that it was necessary to manage the Texas coast, current federal thinking might well lead to the imposition of zoning procedures. The undesirability of such an approach for an area as large and diverse as the Texas coast is evident. Implementation of the recommendations made in Chapter IV would allow Texas to implement procedures and policies that best serve its coastal management needs.

The Coastal Zone Management Act allows a state to increase its influence over federal activities in its coastal zone. The Secretary of Commerce is empowered to require federal agencies, with the exception of the Environmental Protection Agency (EPA), to conform their coastal activities to the state's

approved program to the maximum extent practicable. It should be the burden of the federal agency proposing an activity in the coastal area to prove that the activity does indeed conform to the state's program to the maximum extent practicable.

Perhaps most significantly, under the proposed recommendations, the state would assume permitting power over its wetlands. This power is presently exercised by the Corps of Engineers. The advantage of returning responsibility for this power to the state is seen in the difference between state regulatory proceedings and the proceedings conducted by the Corps. The state regulatory proceedings are quasi-judicial. Only evidence germane to the issues affecting the permit decision may be introduced. Corps proceedings allow any number of opinions to be presented and discussed at great length, whether they are relevant or not. Thus, permit decisions—approvals or rejections—are slowed, and both public and private costs are increased. The length of these hearings does not noticeably improve the quality of the decisions. By assuming permitting authority over the wetlands, the state would be in a position to efficiently make and implement policy in some of its most sensitive coastal areas.

Increased Accountability of State Agencies

This report has detailed the need for a systems approach to coastal policy formation in Texas. Basically, a systems approach to the coast and coastal policy is one which considers the coast to be a whole composed of interacting parts, each related to the other through one or more orderly processes. This view assumes that the alteration of any part of the coastal system is likely to produce changes in other parts and that policy made for any part of the coast must be reviewed for its consequences upon the rest of the coast. At present, no agency or elected official has the mandate or capability to make policy for the coast on a systems basis. Yet an overview of the coast as a system is essential if the state is to accommodate the maximum range of activities in coastal areas while conserving the underlying resource base at an acceptable level. Without a systems approach to the coast, state action can only blindly seek to foster the fullest possible yield of benefits from coastal resources.

The proposed coastal program creates an organization which can review and recommend coastal policy on a systems basis. The work of this group, based upon the state's best expertise and developed in cooperation with the citizens' advisory panel, would establish a persuasive standard for coastal program priorities and performance which would be highly visible to the public, the legislature, and the governor. The state's coastal agencies, if given the NRC's coastal recommendations prior to their own budget and program preparations, could act upon those recommendations or reject them in favor of other views or advice. In either case, the NRC's recommendations would

form a solid basis for open discussion of the state's coastal needs and agency responses. This would result in greater visibility of agency policymaking procedures and greater governmental accountability to the people, the legislature, and the governor. Such discussion of coastal policy would also set the stage for later reviews of the coastal programs developed to meet the state's needs. Program performance could then be measured against the state's identified coastal needs. Because the essential problem of coastal management in Texas is not a lack of policies but a failure to support those policies with adequate funding, performance reviews, and coordinating efforts, the proposed NRC is the appropriate response to the Texas situation. Other states may lack information, policies, programs, or personnel, but in Texas the need is to assure the appropriate ties between budgeting and performance.

Unless the NRC is created, effective policy-level review and recommendation of state coastal policies and needs cannot occur. The present ICNRE consists of agency directors, none of whom is empowered by statute to make policy for his own agency, much less for the coast. Only elected officials and board or commission members have the mandate for policy-level decisions. Recomposition of the ICNRE to create an NRC consisting of board members and elected officials will establish it as a policy-level body. For the first time, the governor, as chief planning officer of the state, will have a group experienced in all aspects of natural resources policy to advise him on state activities.

The use of an activity-assessment procedure to evaluate proposed activities in the coastal area would increase accountability. Systematic assessment of the effects of proposed coastal activities would provide a logical, scientific basis for permit and program decisions. The results of such analyses, available to all participants in permit hearings, would limit the ability of agency permit grantors, through intent or carelessness, to make arbitrary or capricious decisions.

The proposed citizens' advisory panel to the NRC would also increase agency accountability. These individuals would be public monitors of the process by which policies and priority recommendations are made. Their presence at NRC meetings would tend to keep controversial or embarrassing policy and performance issues from being "swept under the carpet." The existence of this advisory group, which would include coastal county officials and have the power to call public hearings, would further open coastal policymaking to public scrutiny and input. Visibility is a step toward accountability.

Increased Efficiency in State Coastal Programs

The NRC would review agency program proposals for conformance with the policies and priorities previously recommended in the NRC's biennial report. This review, conducted by those who proposed the programs and policies, would com-

plement that performed by the Legislative Budget Board (LBB) and the Governor's Budget and Planning Office (GBPO). In fact, the greater familiarity of the NRC with the state's natural resource concerns would mean its assistance could substantially enhance the LBB's and the GBPO's abilities to perform their reviewing functions. Furthermore, because the NRC would be composed of citizen appointees whose jobs and salaries would not be affected by the outcomes of the issues before them, their work would be more readily received as impartial. No matter how dispassionate or objective an agency executive director might be, any recommendation he made which lauded his agency or called for its expansion would not be considered disinterested. Because the board or commission members' primary loyalties to the governor and the people are not thought to be clouded by immediate personal concerns for job and agency prerogatives, they could provide the necessary perspective on the state's coastal efforts.

No single program analyst for the LBB or GBPO now reviews the programs of all the natural resource agencies on the coast, and no analysis of the total natural resource budget for the coast is made. To achieve an effective review of state governmental activity on the coast, agency proposals for coastal programs would have to be identified as such in budget requests. The breaking out of natural resource agency program proposals along policy lines would also serve to point up any duplication in agency requests in a way the state budget process does not presently allow. Agencies would be forewarned that duplication will be noticed, that it is unacceptable, and that systems policy is the standard by which program proposals will be evaluated. The NRC's performance of these functions should substantially increase coordination among state agencies as programs are being planned.

The state's coastal permitting processes are another area in which the proposed recommendations can give greater efficiency. The cost of the permitting process is not simply the amount of funds state agencies devote to permit reviewing. The major cost of permitting is borne by the private individuals and corporations who must apply for permits. It is they who must collect substantial information, analyze it, assemble it, and present it in a form acceptable to state agencies. The proposed program will reduce the cost of obtaining permits in several ways. Analysis of all permit applications with direct and significant impacts on the coastal zone through the proposed activity-assessment procedure will reduce permitting costs by pinpointing the data needed to make sound decisions and indicating data requirements which could be eliminated without a significant effect on permit decisions. By focusing on only those data relevant to a proposed project, state agencies could devote more time to analysis of the important questions and could request applicants to provide key data in more detail where appropriate.

Consistent analysis of all coastal permit applications can further reduce costs to the public and private sector by increasing the predictability of decisions. One of the most important elements of a good economic climate is the predictability of governmental action. Few development interests intentionally plan projects likely to draw substantial public opposition. Delays caused by lengthy administrative and judicial proceedings greatly reduce a project's profitability, even if necessary permits are finally granted. In addition, the prospect of such delays tends to prevent many projects from even being considered. Consistent analysis of applications will speed permit evaluation and make better decisions possible. This will save time and money for the public, for state agencies, and for developers. Predictability in permitting would maintain and enhance Texas' favorable economic climate for quality economic growth.

Use of the proposed activity-assessment process offers still another benefit. Through this process the agencies would be able to identify important data needs that are not being filled by state agency or university research efforts. These information needs could then be given proper consideration in the allocation of state research funds and in applications for federal research grants. This would provide professionals with an incentive to focus their research efforts where the results would best improve the quality of state decision-making.

Research efforts are often duplicated. An NRC review process for research should also encourage researchers, state agencies, universities, and private research organizations to better coordinate their proposals.

Practicality

The program proposed is not the only one which might theoretically meet the problems of the Texas coast. However, it is superior in very important ways to the alternatives considered. First, this program is acceptable to a wide range of coastal interests. It has been refined and improved through a long series of public hearings and advisory committee meetings, in which industry, agriculture, environmentalists, and local government were represented. Second, this program can be effectively implemented by the governor. It is one thing to assemble a coalition to pass legislation; it is quite another to make the legislation work. Several states have assembled political coalitions which passed legislation, coastal and otherwise, only to find their ideas unworkable and themselves divided when the full implications of their plans became clear. The proposed Texas program, building as it does upon present authority and agency responsibilities, could avoid this problem. The NRC is not made a superagency, since it possesses only advisory authority. It imposes no new regulatory requirements on any permit applicant. It proposes no cumbersome new level of government on the taxpayers of the state. It shortens rather

than lengthens the total permit process for development and conservation interests. The program is desirable and workable in the Texas political climate.

POTENTIAL DISADVANTAGES AND COSTS

The Coastal Management Program's recommendations, if adopted, could potentially result in some new costs to the state. These costs would be associated with creating the NRC, implementing the activity-assessment routine, and transferring wetlands permitting authority to the state. Such costs, if any, would be slight, and they would be offset by savings in other areas and by federal funds available to the state for such costs.

In the discussion of the benefits of adopting the proposed program, it has been explained that the program could reduce public costs by decreasing duplication in natural resource activities and by fine-tuning current permit reviewing processes. Increased predictability and more precise data requirements in permitting processes should reduce private costs. A substantial saving in private costs should also result from returning the saltwater wetlands permitting function to the state.

Creation of the NRC and Establishment of the Activity-Assessment Routine

The steps necessary to establish the NRC as a policy-level body, to provide a small support staff, and to analyze A-95 and permit applications through the activity-assessment routine might require some additional expenditures by the state. However, any added costs would be minimal. The data management function required for the activity-assessment routine could be performed by the Texas Natural Resource Information System (TNRIS) using their existing staff and equipment. The procedures recommended would occupy only a very small percentage of their current capacity. TNRIS would be removed from the Texas Water Development Board to the Governor's Office. There would be no additional overhead costs since overhead functions could be transferred between the Texas Water Development Board and the Governor's Office.

The natural resources planning staff currently budgeted in the Governor's Office would be adequate to manage NRC staffing and the coastal management activity-assessment routine. It is possible that some redistribution of staff classifications and salaries would be necessary to ensure the proper mix of professional skills. Because many of these slots are currently vacant, such adjustments pose no real personnel problem. Taken together, the proposals concerning the creation of the NRC, its staffing, and implementation of the activity-assessment process should not result in any significant increase in total state government expenditures for natural resource management.

Costs for Transfer of Wetlands Permitting Procedures

It is estimated that the U.S. Army Corps of Engineers currently spends $600,000 annually in the exercise of its wetlands permitting jurisdiction. Some of this cost will be transferred from federal to state government if the TCMP proposals are adopted. However, the cost of state government will not be increased by the full amount. State agencies, particularly the Parks & Wildlife Department, currently devote substantial time to reviewing and commenting upon permit applications ultimately decided on by the Corps. The amount of review time required to actually reach a decision should not be significantly greater if a portion of this permitting authority is transferred to the state. The use of the activity-assessment routine in processing applications should result in savings as discussed above.

The real savings to the economy of Texas would occur in the private sector. Both environmentalists and industrialists have commented that they find Corps permitting procedures far too long for the purpose they serve. Participation is extremely costly, and the resulting delays in projects are more costly still. The private sector savings from state control of this permitting power should more than offset any increased state costs.

Possibilities of Federal Funding

As mentioned in the previous chapter, it is possible that all or part of the cost of the proposed coastal management program can be met through Coastal Management Act Section 306 funds and Section 701 Planning Grants from the Department of Housing and Urban Development. This would further reduce program implementation costs to the state so that the general revenue fund would not be burdened. In any event, a practical assessment of this program indicates that, with or without federal funds, the costs to the state would not exceed the benefits to the public or private sectors.

Costs of Change

Any new program for management of the coast of Texas will require some changes by state agencies and by private interests. Adapting to a new system consumes time and financial resources, and the costs of such an adaptation, even if they occur only once, must be considered in any calculation of net benefits. The recommendations of the Texas Coastal Management Program carry a very small cost of change because no new regulatory procedures have been introduced. The permit-granting agencies would be unchanged by implementation of the proposed program.

There would be no need for applicants to learn any new intricacies in the regulatory process. This absence of any need

to learn new procedures may be even more important to environmental interests than it is to development interests. Industrial interests can pass the costs of a legal and technical learning period through to their customers as part of the cost of doing business. However, many nonprofit groups would find it difficult to bear this cost, and this would curb their participation until they became familiar with the new processes.

Every new program is launched with optimism that it will turn out to be the success its designers intended. But some fail, and a fair regard for experience makes it reasonable to examine the costs of failure. The success of the proposed program depends not only upon organizational structure but also upon the importance the governor gives to the NRC's recommendations and assessments. With poor personnel or lack of executive support, it is entirely possible that the NRC would never be more than a mediocre debating society.

The cost of failure would be very high if a reorganization of existing natural resource agencies into a superagency were proposed. If that superagency failed, state natural resource programs would grind to a halt; and it would be very costly, if not impossible, to reestablish the previously existing agencies. Furthermore, a superagency would, even if a failure, attract a substantial constituency, and the cost of failure could be quite high, since it would not be politically feasible to discontinue the program even after failure was apparent.

The proposed Texas coastal management program would result in neither of these problems. No disassembly of existing agencies is proposed, and no large staff or other well-organized constituency would be brought into existence. There would be no great political cost if the program were to fail.

In the recently proposed state constitution, one of the most popular items was an article which would have dissolved state agencies after a set number of years. Under the Coastal Management Program's proposed recommendations, the NRC would be dissolved and the ICNRE reinstated after four years if the anticipated benefits were not realized.

These features also make it reasonable to consider the use of federal funds to finance any new state costs. There has often been a reluctance to use federal funds because to do so was to restrict the state in its activities and to run the risk of developing a large program with a politically potent constituency only to see the federal funds disappear. The coastal management program would be approved by the federal government in advance of its implementation. The state has full control over whether it produces a program certifiable by the Secretary of Commerce. If federal funds disappear, and the legislature and governor feel that the program is not worth its costs in state funds, it should be simple and politically feasible to disassemble the program. Analysis of the small costs of change and the costs of failure make the proposed program appear even more feasible.

Control of Cost by Existing Agencies

The ultimate costs of the Coastal Management Program's recommendations will be greatly affected by the degree of cooperation given by state natural resource agencies. The greater this cooperation, the less it will cost to implement the activity-assessment process and the better the NRC will function. The costs of implementing these recommendations will indicate to the governor and legislature how well state agencies are working together on coastal policy issues.

SUMMARY

The benefits to be derived from adoption of the proposed Texas coastal management program should greatly outweigh any foreseeable disadvantages or costs. As the program's recommendations are further defined, more detailed calculations of advantages and disadvantages estimates will be possible. However, it appears at this time that further definition of the proposals is unlikely to alter the present very desirable balance of advantages over disadvantages for both the private and public sectors.

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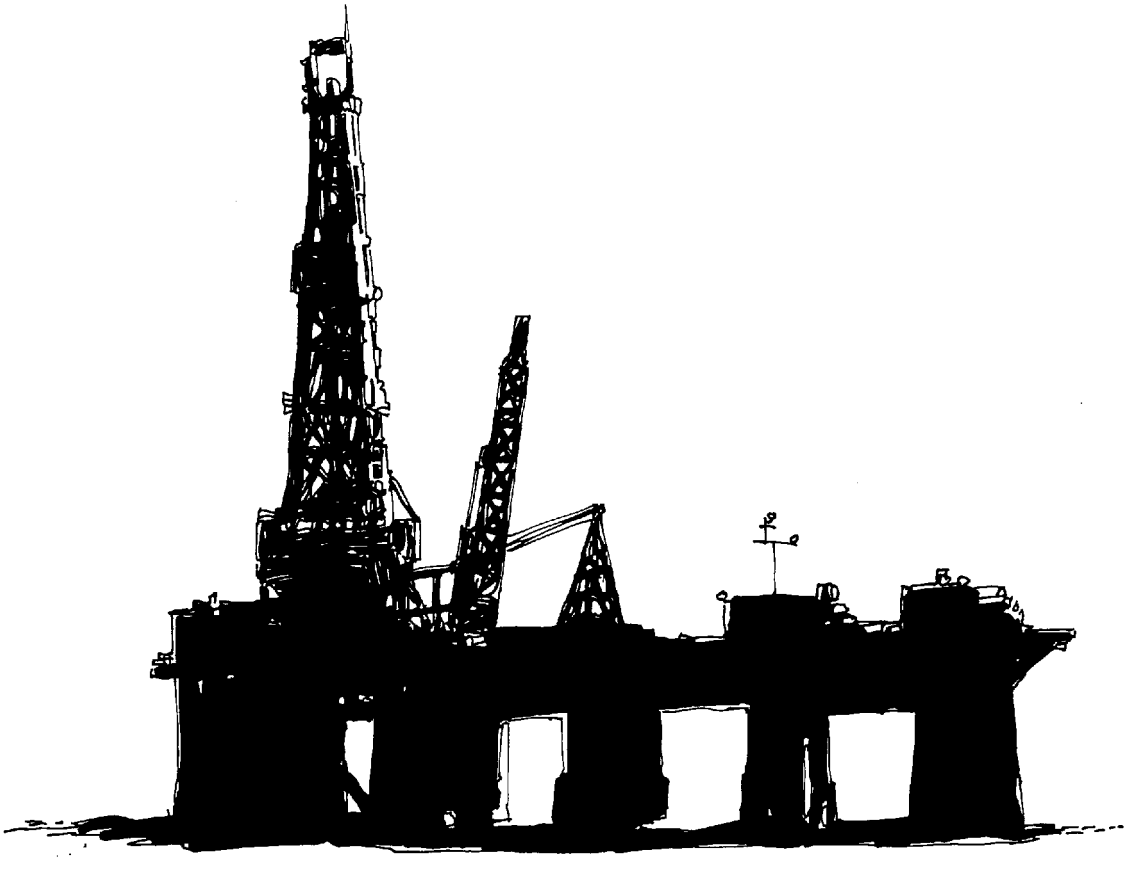

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 1A
COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS

Map Information based on:

L. F. Brown, Jr., project coordinator, Environmental Geologic Atlas of the Texas Coastal Zone; University of Texas at Austin, Bureau of Economic Geology

NOTICE: Map information presented herein is generalized. Because of small scale (one inch equals approximately four miles), many small features do not appear. These maps should, therefore, be used only as a regional overview of resources and not for on-site decision-making. A more detailed version of these maps can be found on open file at the General Land Office, 1700 N. Congress Avenue, Austin, Texas, 78701.

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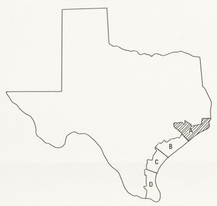

CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

LEGEND

NEARSHORE GULF
Salinity 35 ppt; temperature 13-31°C; turbidity lower than surf zone; more nutrients than open ocean, less than bays; currents large scale, slow and parallel to shore; depth 15 to several hundred feet; little relief; mud with sand substrate; diverse plankton and benthos; numerous predacious fishes; high species diversity

INLET/TIDAL DELTA
Variable salinity 1-25 ppt; temperature 10-30°C; high turbidity; large amounts of organic material possible; strong currents possibly stratified vertically; sediment transport; depth to 40 ft.; substrate variable – mud and sand; diverse fauna adapted to high current energy or migrating forms; fluctuating biomass

MEDIUM SALINITY BAY
Salinity 18-25 ppt; temperature 1-30°C; turbidity and nutrients very considerable; complex circulation; water vertically mixed; depth 6-15 ft.; usually low bottom relief; substrate mottled mud; diverse plankton and biota; 4-5 level food chain

BAY TRANSITIONAL AREA
Characteristics highly variable, site-specific; movement of water dependent on nature of adjacent natural areas; shallow, often less than 3 ft. deep; substrate sand and mud (tendor where currents are substantial); sparse sea grasses, possible concentration of juvenile organisms; nature of biota depends on adjacent areas

RESTRICTED BAY
Salinity variable, generally 10-25 ppt; occasional low O_2 concentrations possible; little tidal influence; circulation limited except for wind and storm tides; shallow, 3-6 ft. deep; restricted outlet; mud substrate; sparse sea grasses; species similar to medium-salinity bay, though less diverse

HYPERSALINE BAY OR LAGOON
Salinity 30-60 ppt; temperature 0-40°C; turbidity variable; often high level of nutrients; unusual ion concentrations; circulation often wind-dependent; restricted circulation; depth to 12 ft.; lagoons generally long, narrow, and parallel to shore; complex substrates; generally low species diversity; some sea grasses; blue-green algae; abundant mollusks

REEF AND REEF FLANK AREAS
Oyster reef areas: salinity 8-35 ppt; temperature 10-30°C; generally high levels of organic materials; often associated with well established currents; depth 0-6 ft.; generally normal circulation; substrates of sand, mud, and shell debris; high species diversity; variety of invertebrates attract carnivores; serpulid reefs occur in higher salinity areas in the Baffin Bay system

GRASSFLATS (HYPERSALINE)
Temperature and salinity similar to hypersaline lagoon; circulation wind-related; waters well mixed; currents low to moderate; depth 1-4 ft.; soft, smooth bottom; substrate sand with mud and shell, rich in organic material; greater species diversity than lagoon; algae, many epiphytic; abundant molluscs, carnivorous fishes tolerant of salinity levels

GRASSFLATS (MODERATE SALINITY)
Temperature and salinity site-specific, related to adjacent areas; low turbidity; wave action reduced by grass; more tidal influence than hypersaline grassflat; depth 1-5 ft.; often coincident with bay margins; substrate mud to muddy sand with some shell; high species diversity, complex trophic structure

SPOIL DEPOSITS
Both subaerial and subaqueous areas characterized by very high turbidity; water conditions altered during active spoil placement; complex circulation; currents variable as deposits may block flow; no characteristic depth; morphological characteristics site-specific; no indicative biological features; may be used by birds for nesting; following invertebrates that colonizes of new sediment; industrial areas may be barren; may be stabilized by vegetation; local rookery sites

The landward extent of map units comprising composite resource areas delineates the inland boundary of the Texas Coastal Management Program. The management area lies between the inland boundary and the three league line.

CHANNEL
Often high turbidity; distinct salinity and temperature gradients; effluents may be considerable; rapid water flow; flow may be unidirectional, net direction of flow generally landward but may vary; depth to 45 ft.; steep sides; bare-packed substrate cleared of sediment in areas of high flow, otherwise sand or silt; biota similar to inter/tidal delta; most life forms burrow, attach to hard substrate, use channel for migration, or are planktonic; large seasonal fluctuations in biomass

COASTAL LAKES
Often serve as inflection areas for water flowing in and out of marshes and nearby upland areas; generally shallow, often circular and pan-shaped; salinity, temperature, O_2, nutrients, and turbidity similar to marsh; water movement variable; substrate sand to mud with high organic content; blue-green algal mats may be layered on the bottom; consumers similar to tidal marsh though less dense; may contain sparse marsh grasses; in some areas may be artificially impounded

TIDAL STREAM REACHES
Extremely variable water conditions; turbidity and nutrients usually higher than other natural areas; salinity 3-35 ppt; O_2 often below saturation; ion concentrations may be unusual; effluents may be high; net water movement is toward bay; with frequent tidal influence and mixing of fresh and estuarine waters; waters well mixed, no distinct salt wedge; depth varies 4-40 ft.; usually meandering streams; watercourse often altered by erosion and accretion; sand substrate characteristic of high flow, mud substrate of low flow; biota highly variable depending on salinity; species range from fresh-water to estuarine; turbidity limits phytoplankton production; some marsh plants

RIVER-INFLUENCED BAY
Salinity 0-10 ppt; temperature varies seasonally with inflow; turbidity usually high; high nutrient levels; often well-defined circulation toward Gulf; salinity gradient may exist; depth 3-7 ft.; large sediment flux; normally smooth bottom; sediments rich in organic matter; fluctuating populations of juvenile organisms; low species diversity

BEACH/UPPER SHOREFACE
Salinity 25-35 ppt; temperature 0-34°C; high turbidity; considerable organic matter; strong wave action; strong currents; high tide swash zone to 15 ft. depth; sand bars; sandy substrate; small interstitial inhabitants; larger, benthic invertebrates; predators (fishes and birds)

WIND-TIDAL FLATS
Temperature and salinity depend on adjacent areas; turbidity and nutrients variable; circulation dependent on wind and tides; waters well mixed; movement generally perpendicular to shore, +2 to -1 MSL; very low relief; sand substrate with mud; sediment rich in organic material; blue-green algae; numerous invertebrates; omnivores and carnivores

COASTAL WETLANDS
Includes salt-water marsh, brackish-water marsh, and fresh-to-brackish-water marsh; subject to tidal inundation; salinity ranges from almost marine to almost fresh; high nutrient levels; turbidity variable; periodic inundation and flushing through tidal channels; mean low tide to +3 ft. above mean low tide; substrate sand to silt; vascular marsh vegetation; large amounts of decayed plant matter form base of food chain; bacteria and other decomposers important; nursery ground for many species

WASHOVER CHANNEL COMPLEX
Located on barrier island, 0-5 ft. MSL; connects bay or lagoon to Gulf during periods of very high water; substrate sand with mud; moisture content of substrate 4-20%; plant growth limited by salt content; fauna generally burrowing crustaceans similar to those found on higher parts of beach

ACTIVE DUNE COMPLEX
Located on barrier islands or adjacent to Gulf shorefaces; height to +4 ft.; rarely 58 ft.; substrate fine to very fine sand, low in organic matter, moisture content of substrate very low; includes fore-island dune ridge, fore-island and back-island blow-out dunes, and stabilized blow-out dunes; except for stabilized areas, vegetation sparse and few plant species represented; fauna generally transient including insects, shorebirds, small rodents, and vertebrate predators

COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS
UPPER TEXAS COASTAL REGION 1976

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 2.5 0 5 10 15 20 25 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 1B

COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS

LEGEND

The landward extent of map units comprising composite resource areas delineates the inland boundary of the Texas Coastal Management Program. The management area lies between the inland boundary and the three league line.

NEARSHORE GULF

Salinity 35 ppt; temperature 12-32°C; turbidity lower than surf zone; more nutrients than open ocean, less than bays; currents large-scale, slow, and parallel to shore; depth 15 to several hundred feet; little relief; mud with sand substrate; diverse plankton and benthos; numerous predacious fishes; high species diversity

INLET/TIDAL DELTA

Variable salinity 1-35 ppt; temperature 10-30°C; high turbidity; large amounts of organic material possible; strong currents possibly stratified vertically; sediment transport; depth to 40 ft.; substrate variable – mud and sand; diverse fauna adapted to high current energy or migrating forms; fluctuating biomass

MEDIUM SALINITY BAY

Salinity 10-35 ppt; temperature 1-30°C; turbidity and nutrients very considerable; complex circulation; water vertically mixed; depth 6-15 ft.; usually low bottom relief; substrate mottled mud; diverse plankton and biota; 4-5 level food chain

BAY TRANSITIONAL AREA

Characteristics highly variable; site-specific; movement of water dependent on nature of adjacent natural areas; shallow, often less than 3 ft. deep; substrate sand and mud boarder where currents are substantial; sparse sea grasses; possible concentration of juvenile organisms; nature of biota dependent on adjacent areas

RESTRICTED BAY

Salinity variable, generally 10-35 ppt; occasional low O_2 concentrations possible; little tidal influence; circulation limited except for wind and storm tides; shallow, 3-6 ft. deep; restricted outlet; mud substrate; sparse sea grasses, species similar to medium-salinity bay, though less diverse

HYPERSALINE BAY OR LAGOON

Salinity 30-60 ppt; temperature 0-40°C; turbidity variable; often high level of nutrients; unusual ion concentrations; circulation often wind-dependent; restricted circulation; depth to 12 ft.; lagoons generally long, narrow, and parallel to shore; complex substrates; generally low species diversity; some sea grasses; blue-green algae; abundant mollusc

REEF AND REEF FLANK AREAS

Oyster reef areas: salinity 8-35 ppt; temperature 10-30°C; generally high levels of organic materials; often associated with well established currents; depth 0-8 ft.; generally normal circulation; substrate of sand, mud, and shell debris; high species diversity; variety of invertebrates attract carnivores; serpentid reefs occur in higher salinity areas in the Baffin Bay vicinity

GRASSFLATS (HYPERSALINE)

Temperature and salinity similar to hypersaline lagoon; circulation wind-related; waters well mixed; currents low to moderate; depth 1-4 ft.; soft, smooth bottom; substrate sand with mud and shell, rich in organic material; greater species diversity than lagoon; algae, many typiphytic; abundant molluscs; carnivorous fishes tolerant of salinity levels

GRASSFLATS (MODERATE SALINITY)

Temperature and salinity site-specific, related to adjacent areas; low turbidity; wave action reduced by grass; more tidal influence than hypersaline grassflat; depth 1-6 ft.; often coincident with bay margins; substrate mud to muddy sand with some shell; high species diversity; complex trophic structure

SPOIL DEPOSITS

Both subaerial and subaqueous areas characterized by very high turbidity; water conditions altered during active spoil placement; complex circulation; currents variable as deposits may block flow; no characteristic depth; morphological characteristics site-specific; no indicative biological community; fauna generally from nearby natural areas; burrowing invertebrates first colonizers of new sediment; subaerial areas may be barren land or may be stabilized by vegetation; local nuisance sites

CHANNEL

Often high turbidity; distinct salinity and temperature gradients; effluents may be considerable; rapid water flow; flow may be stratified; net direction of flow generally Gulfward but may vary; depth to 45 ft.; steep sides; hard-packed substrate cleared of sediment in areas of high flow, otherwise sand or silt; biota similar to inter/tidal delta; most life forms burrow, attach to hard substrate, use channel for migration, or are planktonic; large seasonal fluctuations in biomass

COASTAL LAKES

Often serve as collection areas for water flowing in and out of marshes and nearby upland areas; generally shallow, often circular and pan-shaped; salinity, temperature, O_2, nutrients, and turbidity similar to marsh; water movement variable, substrate sand to mud with high organic content; blue-green algal mats may be layered on the bottom; consumers similar to tidal marsh though less dense; may contain sparse marsh grasses; in some areas may be artificially impounded

TIDAL STREAM REACHES

Extremely variable water conditions; turbidity and nutrients usually higher than other natural areas; salinity 3-35 ppt; O_2 often below saturation; ion concentrations may be unusual; effluents may be high; net water movement is toward bay, with frequent tidal influence and mixing of fresh and estuarine waters; waters well mixed, no distinct salt wedge; depth varies 4-40 ft.; usually meandering streams; watercourse often altered by erosion and accretion; sand substrate characteristic of high flow, mud substrate of low flow; biota highly variable depending on salinity; species range from fresh water to estuarine; turbidity limits phytoplankton production; some marsh plants

RIVER-INFLUENCED BAY

Salinity 0-10 ppt; temperature varies especially with inflow; turbidity usually high; high nutrient levels; often well-defined circulation toward Gulf; salinity gradient may exist; depth 3-7 ft.; large sediment flux; normally smooth bottom; sediments rich in organic matter; fluctuating populations of juvenile organisms; low species diversity

BEACH/UPPER SHOREFACE

Salinity 20-35 ppt; temperature 9-35°C; high turbidity; considerable organic matter; strong wave action; strong currents; high tide swash zone to 15 ft. depth; sand bars; sandy substrate; small interstitial inhabitants; larger benthic invertebrates; predatory fishes (fluke and birds)

WIND-TIDAL FLATS

Temperature and salinity depend on adjacent areas; turbidity and nutrients variable; circulation dependent on wind and tides; waters well mixed; movement generally perpendicular to shore, <2 to 1 MSL; very low relief; sand substrate with mud; sediment rich in organic material; blue-green algae, numerous invertebrates, omnivores and carnivores

COASTAL WETLANDS

Includes salt water marsh, brackish-water marsh, and fresh to brackish-water marsh; subject to tidal inundation; salinity ranges from almost marine to fresh; O_2 low; nutrients high; turbidity variable; periodic inundation and flushing through tidal channels; mean low tide to +3 ft. above mean low tide; substrate sand to silt, vascular marsh vegetation; large amounts of deposed plant matter form base of food chain; bacteria and other decomposers important; nursery ground for many species

WASHOVER CHANNEL COMPLEX

Located on barrier island, 0-5 ft. MSL; connects bay or lagoon to Gulf during periods of very high water; substrate sand with mud; moisture content of substrate 4-20%; plant growth limited by salt content; fauna generally burrowing crustaceans similar to those found on higher parts of beach

ACTIVE DUNE COMPLEX

Located on barrier islands or adjacent to Gulf shoreface; height to 40 ft. rarely 50 ft.; substrate fine to very fine sand, low in organic matter; moisture content of substrate very low; includes fore-island dune ridge, fore-island and back-island blow-out dunes, and stabilized blow-out dunes except for stabilized areas, vegetation sparse and few plant species represented; fauna generally transient including insects, shorebirds, small rodents, and vertebrate predators

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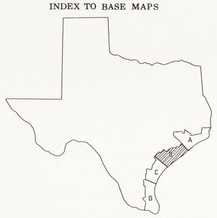

Map information based on:

L. F. Brown, Jr., project coordinator, Environmental Geologic Atlas of the Texas Coastal Zone; University of Texas at Austin, Bureau of Economic Geology

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CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS
UPPER TEXAS COASTAL REGION 1976

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 2.5 0 5 10 15 20 25 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 1C
COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS

LEGEND

The landward extent of map units comprising composite resource areas delineates the inland boundary of the Texas Coastal Management Program. The management area lies between the inland boundary and the three league line.

NEARSHORE GULF
Salinity 35 ppt; temperature 12-32 °C; turbidity lower than surf zone; more nutrients than open ocean, less than bays; currents large scale, slow, and parallel to shore; depth 15 to several hundred feet; little relief; mud,earth sand substrate; diverse plankton and benthos; numerous predacious fishes, high species diversity

INLET/TIDAL DELTA
Variable salinity 7-35 ppt; temperature 10-35 °C; high turbidity; large amounts of organic material possible; strong currents probably stratified vertically; sediment transport; depth to 40 ft.; substrate variable — mud and sand; diverse fauna adapted to high current energy or migrating forms; fluctuating biomass

MEDIUM SALINITY BAY
Salinity 10-35 ppt; temperature 1-35 °C; turbidity and nutrients vary considerably; complex circulation; water vertically mixed; depth 6-15 ft., usually low bottom relief; substrate mottled mud; diverse plankton and biota; 4-5 level food chain

BAY TRANSITIONAL AREA
Characterized by highly variable, site-specific movement of water dependent on nature of adjacent natural areas; shallow, often less than 3 ft. deep; substrate sand and mud; boarder where currents are substantial; sparse sea grasses; possible concentration of juvenile organisms; nature of biota depends on adjacent areas

RESTRICTED BAY
Salinity variable, generally 10-35 ppt; occasional low O_2 concentrations possible; little tidal influence; circulation limited except for wind and storm tides; shallow, 3-8 ft. deep; restricted outlet; mud substrate; sparse sea grasses; species similar to medium-salinity bay, though less diverse

HYPERSALINE BAY OR LAGOON
Salinity 30-60 ppt; temperature 0-40 °C; turbidity variable; often high level of nutrients; unusual ion concentrations; circulation often wind-dependent; restricted circulation; depth to 12 ft.; lagoons generally long, narrow, and parallel to shore; complex substratum, generally low species diversity; some sea grasses; blue-green algae; abundant mollusks

REEF AND REEF-FLANK AREAS
Oyster reef areas; salinity 0-35 ppt; temperature 10-35 °C; generally high levels of organic materials; often associated with well established currents; depth 0-6 ft.; generally normal circulation; substratum of sand, mud, and shell debris; high species diversity; variety of invertebrates attract carnivores; lensoid reefs occur in higher salinity areas in the Baffin Bay vicinity

GRASSFLATS (HYPERSALINE)
Temperature and salinity similar to hypersaline lagoon, circulation wind-related; waters well mixed; currents low to moderate; depth 1-4 ft.; soft, smooth bottom; substrate sand with mud and shell, rich in organic material; greater species diversity than lagoon; algae, many epiphytic; abundant mollusks, carnivorous fishes tolerant of salinity levels

GRASSFLATS (MODERATE SALINITY)
Temperature and salinity site-specific, related to adjacent areas; low turbidity, wave action reduced by grass; more tidal influence than hypersaline grassflat, depth 1-5 ft.; often coincident with bay margins, substrate mud to muddy sand with some shell; high species diversity, complex trophic structure

SPOIL DEPOSITS
Both subaerial and subaqueous areas characterized by very high turbidity; water conditions altered during active spoil placement; complex circulation; currents variable as deposits may block flow; no characteristic depth; morphological characteristics site-specific; no indicative biological community; fauna generally from nearby natural areas; burrowing invertebrates first colonizers of new sediment; subaerial areas may be barren land or may be stabilized by vegetation; local rookery sites

CHANNEL
Often high turbidity; distinct salinity and temperature gradients; effluents may be considerable; rapid water flow, flow may be stratified; net direction of flow generally Gulfward but may vary; depth to 45 ft.; steep sides, hard-packed substrate cleared of sediment in areas of high flow, otherwise sand or silt; biota similar to interchabt delta; most life forms burrow, attach to hard substrate, use channel for migration, or are planktonic; large seasonal fluctuations in biomass

COASTAL LAKES
Often serve as collection areas for water flowing in and out of marshes and nearby upland areas; generally shallow, often circular and perchaped; salinity, temperature, O_2, nutrients, and turbidity similar to marsh; water movement variable; substrate sand to mud with high organic content; blue-green algal mats may be layered on the bottom; consumers similar to tidal marsh though less dense; may contain sparse marsh grasses, in some areas may be artifically impounded

TIDAL STREAM REACHES
Extremely variable water conditions; turbidity and nutrients usually higher than other natural areas; salinity 5-35 ppt; O_2 often below saturation; no concentrations may be unusual; effluents may be high; net water movement is toward bay, with frequent tidal influence and mixing of fresh and estuarine waters; waters well mixed, no distinct salt wedge, depth varies 4-40 ft.; usually meandering streams; watercourse often altered by erosion and accretion; sand substrate characteristic of high flow, mud substrate of low flow; biota highly variable depending on salinity; species range from fresh-water to estuarine; turbidity limits phytoplankton production; some marsh plants

RIVER-INFLUENCED BAY
Salinity 0-10 ppt; temperature varies especially with inflow; turbidity usually high; high nutrient levels; often well-defined circulation toward Gulf; salinity gradient may exist; depth 3-7 ft.; large sediment flux; normally smooth bottom; sediments rich in organic matter; fluctuating populations of juvenile organisms; low species diversity

BEACH/UPPER SHOREFACE
Salinity 20-35 ppt; temperature 0-25 °C; high turbidity; considerable organic matter; strong wave action; strong currents; high tide swash zone to 15 ft. depth; sand bars; sandy substrate; small interstitial inhabitants; larger benthic invertebrates; predators (fishes and birds)

WIND-TIDAL FLATS
Temperature and salinity depend on adjacent areas; turbidity and nutrients variable; circulation dependent on wind and tides; waters well mixed; movement generally perpendicular to shore, +2 to -1 MSL; very low relief; sand substrate with mud; sediment rich in organic material; blue-green algae; numerous invertebrates; omnivores and carnivores

COASTAL WETLANDS
Includes salt water marsh, brackish-water marsh, and fresh-to-brackish-water marsh; subject to tidal inundation; salinity ranges from almost marine to almost fresh; high nutrient levels; turbidity variable; periodic inundation and flushing through tidal channels; mean low tide to +2 ft. above mean low tide; substrate sand to silt, saltwater marsh vegetation; large amounts of decayed plant matter form base of food chain; bacteria and other decomposers important; nursery ground for many species

WASHOVER CHANNEL COMPLEX
Located on barrier island; 0-5 ft. MSL; connects bay or lagoon to Gulf during periods of very high water; substrate sand with mud; moisture content of substrate 4-20%; plant growth limited by salt content; fauna generally burrowing crustaceans similar to those found on higher parts of beach

ACTIVE DUNE COMPLEX
Located on barrier islands or adjacent to Gulf shoreface; height to 40 ft, rarely 50 ft.; substrate fine to very fine sand, low in organic matter, moisture content of substrate very low; includes fore-island dune ridge, fore-island and back-island blow-out dunes, and stabilized blow-out dunes; except for stabilized areas, vegetation sparse and few plant species represented; fauna generally transient including insects, shorebirds, small rodents, and vertebrate predators

Map Information based on:

L. F. Brown, Jr., project coordinator, Environmental Geologic Atlas of the Texas Coastal Zone; University of Texas at Austin, Bureau of Economic Geology

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Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 2.5 0 5 10 15 20 25 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 1D
COMPOSITE RESOURCE AREAS OF COASTAL WATERS AND ADJACENT SHORELANDS

LEGEND

The landward extent of map units comprising composite resource areas delineates the inland boundary of the Texas Coastal Management Program. The management area lies between the inland boundary and the three league line.

NEARSHORE GULF
Salinity 35 ppt; temperature 12-32°C; turbidity lower than surf zone; more nutrients than open ocean, less than bays; currents large-scale, slow, and parallel to shore; depth 15 to several hundred feet; little relief; mud with sand substrate; diverse plankton and benthos; numerous predacious fishes; high species diversity

INLET/TIDAL DELTA
Variable salinity 1-35 ppt; temperature 10-30°C; high turbidity; large amounts of organic material possible; strong currents possibly stratified vertically; sediment transport; depth to 40 ft +; substrate variable – mud and sand; diverse fauna adapted to high current energy or migrating forms; fluctuating biomass

MEDIUM SALINITY BAY
Salinity 10-25 ppt; temperature 7-29°C; turbidity and nutrients very considerable; complex circulation; water vertically mixed; depth 6-15 ft +; usually has bottom relief; substrate mottled mud; diverse plankton and biota; 4-5 level food chain

BAY TRANSITIONAL AREA
Characteristics highly variable, site-specific; movement of water dependent on nature of adjacent natural areas; shallow, often less than 3 ft. deep; substrate sand and mud; benthic where currents are substantial; sparse sea grasses; possible concentration of juvenile organisms; nature of biota depends on adjacent areas

RESTRICTED BAY
Salinity variable, generally 10-35 ppt; occasional low O_2 concentrations possible; little tidal influence; circulation limited except for wind and storm tides; shallow, 3-6 ft. deep; restricted outlet; mud substrate; sparse sea grasses; species similar to medium-salinity bay, though less diverse

HYPERSALINE BAY OR LAGOON
Salinity 30-60 ppt; temperature 0-40°C; turbidity variable; often high level of nutrients; unusual ion concentrations; circulation often wind-dependent; restricted circulation; depth to 12 ft.; lagoons generally long, narrow, and parallel to shore; complex substrates; generally low species diversity; some sea grasses; blue-green algae; abundant mollusks

REEF AND REEF FLANK AREAS
Oyster reef areas: salinity 9-35 ppt; temperature 10-35°C; generally high levels of organic materials; often associated with well established currents; depth 0-6 ft.; generally complex substrates; substrates of sand, mud, and shell debris; high species diversity; variety of invertebrates attract carnivorous, serpulid reefs occur in higher salinity areas in the Buffon Bay vicinity

GRASSFLATS (HYPERSALINE)
Temperature and salinity similar to hypersaline lagoon; circulation wind-related; waters well mixed; currents low to moderate; depth 1-4 ft.; soft, smooth bottom; substrate sand with mud and shell, rich in organic material; greater species diversity than lagoon; algae, many epiphytic; abundant mollusks; carnivorous fishes tolerant of salinity levels

GRASSFLATS (MODERATE SALINITY)
Temperature and salinity site-specific; related to adjacent areas; low turbidity; wave action reduced by grass; more tidal influence than hypersaline grassflat; depth 1-5 ft.; often coincident with bay margins; substrate mud to muddy sand with some shell; high species diversity; complex trophic structure

SPOIL DEPOSITS
Both subaerial and subaqueous areas characterized by very high turbidity; water conditions altered during active spoil placement; complex circulation; currents variable as deposits may block flow; no characteristic depth; morphological characteristics site-specific; no indicative biological community; fauna generally from nearby natural areas; borrowing overtakes first colonizers of new sediment; subaerial areas may be barren land or may be stabilized by vegetation; boat rookery sites

CHANNEL
Often high turbidity; distinct salinity and temperature gradients; effluents may be considerable; rapid water flow; flow may be stratified; net direction of flow generally Gulfward but may vary; depth to 45 ft.; steep sides; hard-packed substrate cleared of sediment in areas of high flow, otherwise sand or silt; biota similar to inlet/tidal delta; most life forms burrow, attach to hard substrate, use channel for migration, or are planktonic; large seasonal fluctuations in biomass

COASTAL LAKES
Often serve as collection areas for water flowing in and out of marshes and nearby upland areas; generally shallow, often circular and pan-shaped; depth 1-6 ft.; salinity 0-35 ppt; temperature 0-35°C; turbidity similar to marsh; water movement variable; substrate sand to mud with high organic content; blue-green algal mats may be bizarre on the bottom; consumers similar to tidal marsh though less dense; may contain sparse marsh grasses, in some areas may be artificially impounded

TIDAL STREAM REACHES
Extremely variable water conditions; turbidity and nutrients usually higher than other natural areas; salinity 0-25 ppt; O_2 often below saturation; ion concentrations may be unusual; effluents may be high; net water movement is toward Sea, with fluctuation tidal influence and mixing of fresh and estuarine waters; waters well mixed, no distinct salt wedge; depth varies 4-40 ft.+; usually meandering streams; watercourse often altered by erosion and accretion; sand substrate characteristic of high flow, mud substrate of low flow; biota highly variable depending on salinity; species range from fresh-water to estuarine; turbidity limits phytoplankton production; some mash plants

RIVER-INFLUENCED BAY
Salinity 0-10 ppt; temperature varies especially with inflow; turbidity usually high; high nutrient levels; often well-defined circulation toward Gulf; salinity gradient may exist; depth 2-7 ft.; large sediment flux; normally smooth bottom; sediments rich in organic matter; fluctuating populations of juvenile organisms; few species diversity

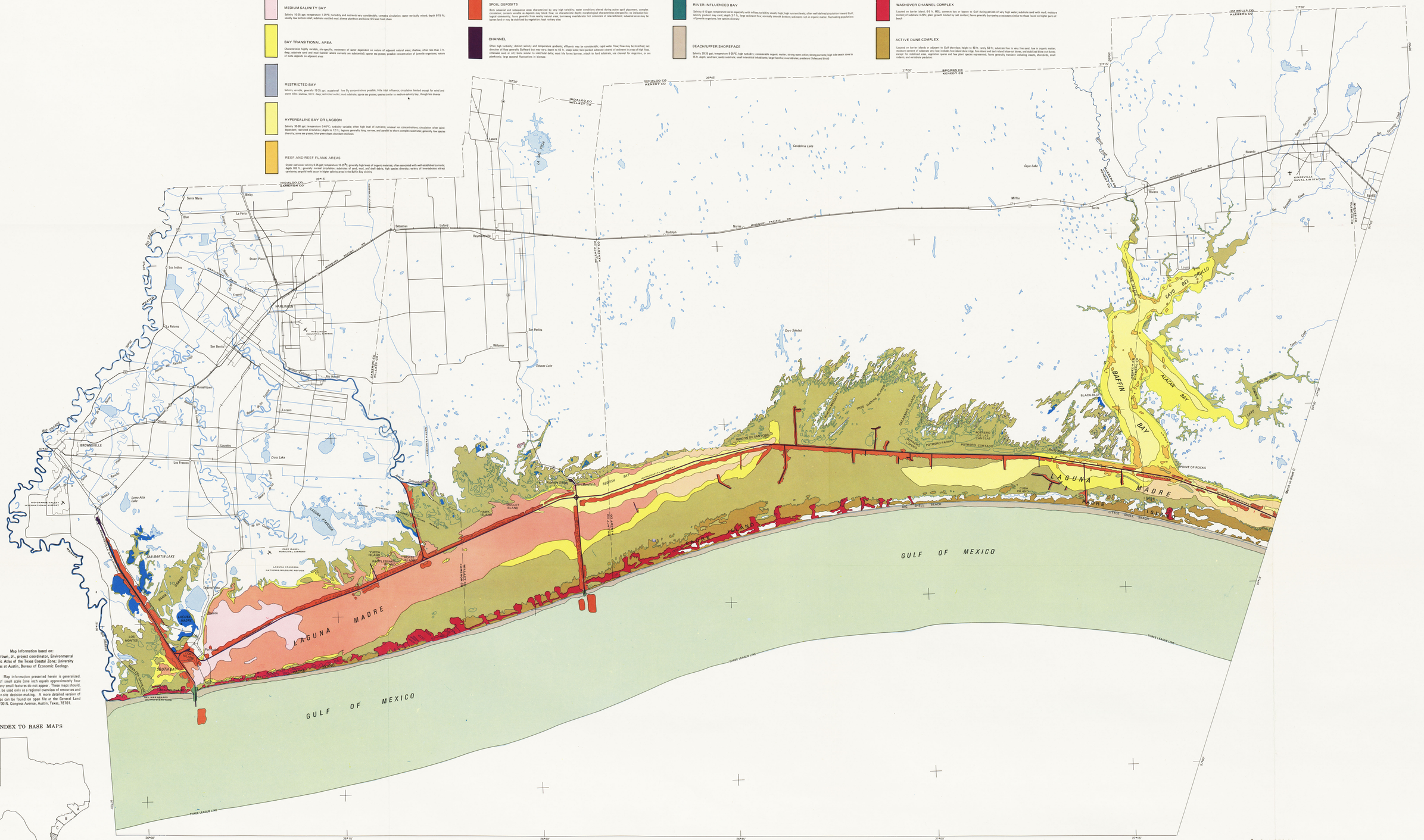
BEACH/UPPER SHOREFACE
Salinity 20-35 ppt; temperature 9-35°C; high turbidity; considerable organic matter; strong wave action; strong currents; high tide swash zone to 15 ft. depth; sand barr; sandy substrate; small interstitial inhabitants; larger benthic invertebrates; predators (fishes and birds)

WIND-TIDAL FLATS
Temperature and salinity depend on adjacent areas; turbidity and nutrients variable; circulation dependent on wind and tides; waters well mixed; movement generally perpendicular to shore; <2 to 1 MSL; very low relief; sand substrate with mud; sediment rich in organic material; blue-green algae; numerous invertebrates, ostracods and carnivores

COASTAL WETLANDS
Includes salt water marsh, brackish-water marsh, and fresh-to brackish-water marsh; subject to tidal inundation; salinity ranges from almost marine to almost fresh; high nutrient levels; turbidity variable; periodic inundation and flushing through tidal channels; mean low tide to +3 ft. above mean low tide; substrate sand to silt, vascular marsh vegetation; large amounts of decayed plant matter from base of food chain; bacteria and other decomposers important; nursery ground for many species

WASHOVER CHANNEL COMPLEX
Located on barrier island; 0-5 ft. MSL; connects bay or lagoon to Gulf during periods of very high water; substrate sand with mud; moisture content of substrate 4-20%; plant growth limited by salt content; fauna generally burrowing crustaceans similar to those found on higher parts of beach

ACTIVE DUNE COMPLEX
Located on barrier islands or adjacent to Gulf shorefaces; height to 40 ft.+; sandy 50 ft.; substrate fine to very fine sand, low in organic matter, moisture content of substrate very low; includes fore-island dune ridge, fore-island and back-island trough or dune flats, and stabilized blow-out dunes; except for stabilized areas, vegetation sparse and few plant species represented; fauna generally transient including insects, shorebirds, small rodents, and vertebrate predators



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Scale 1:250,000
5 0 5 10 15 20 Statute Miles
5 2.5 0 5 10 15 20 25 Kilometers

PLATE 2A

FEDERAL LANDS AND AREAS OF NATIONAL INTEREST

ADDENDUM A

UNMAPPED AREAS

These areas are either too small to appear at this scale or were not precisely located by the respective agencies.

AREA	ACREAGE	COUNTY	STATUS
Bureau of Outdoor Recreation			
Copano Bay St. Recreation Area	2	Aransas	ANI
T.V. Dunear Memorial Park	68	Brazoria	ANI
Port Lavaca Fishing Pier Park	9	Calhoun	ANI
Isla Blanca Co. Park	5	Cameron	ANI
Airport General Park & Playfield	25	Galveston	ANI
Seawolf Park	9	Galveston	ANI
Carver Park	20	Galveston	ANI
Highland Bayou Community Park	1	Galveston	ANI
Stevenson Memorial Park	10	Galveston	ANI
Friendswood Parks Addition	8	Galveston	ANI
Houston Pocket Parks	2	Harris	ANI
EAP Creek Park	2168	Harris	ANI
Memorial Park	24	Harris	ANI
Fairmont Park	6	Harris	ANI
Laporte Recreation Area	1	Harris	ANI
Baytown Community Parks	9	Harris	ANI
Pathway & Parkway	3	Harris	ANI
South Mayo Park	21	Harris	ANI
Nassau Bay City Park	13	Harris	ANI
Baytown Athletic Park	86	Harris	ANI
Springwood Park Pool	8	Harris	ANI
Feiffer Park	5	Harris	ANI
LaPorte Mini Bike Park	5	Harris	ANI
LaPorte Central Park	5	Harris	ANI
Trinity Gardens	6	Harris	ANI
Armand Bayou Regional Park	961	Harris	ANI
League of Women Voters Park	6	Harris	ANI
Satsuma Park	6	Harris	ANI
Avenue Park	8	Harris	ANI
Webster City Park	8	Harris	ANI
Miramar Park	4	Harris	ANI
Port Lavaca Public Pool	5	Calhoun	ANI
Seadrift Fishing Pier	1	Calhoun	ANI
Brownsville Park	15	Cameron	ANI
San Benito Recreation Park	30	Cameron	ANI
Public Boat Launching Ramp	67	Jefferson	ANI
Port Arthur Ballfield	60	Jefferson	ANI
Cecil Reynolds Park	5	Jefferson	ANI
Beaumont Athletic Complex	123	Jefferson	ANI
Nederland Heritage Park	20	Jefferson	ANI
Bay City Swimming Pool Park	25	Matagorda	ANI
Orange County Park	449	Orange	ANI
Ridgemont Park	2	Orange	ANI
West Guth Park	68	Nueces	ANI
Port Aransas Park	122	Nueces	ANI
Portland City Park	13	Nueces	ANI
Bishop City Park	20	Nueces	ANI
Oso Fishing Bridge	1	Nueces	ANI
Victoria Zoological Park	6	Victoria	ANI
Camp Wallace	631	Galveston	ANI
Kingsville Naval Air Station	534	Kleberg	ANI
Pelican Island	3	Galveston	ANI
Naval Reserve Center	1	Galveston	ANI
Galveston Harbor	391	Galveston	ANI
Navy Park Housing Project	4	Orange	ANI
Fort Crockett	2	Galveston	ANI
Buffalo Bayou Flood Control Project	107	Harris	ANI
Port Arthur Dike & Jetty Project	121	Nueces	ANI
Rockport Memorial Park	Not Given	Aransas	ANI
Brazos River Recreation Area	Not Given	Brazoria	ANI
Harris County Parks Acquisition	Not Given	Harris	ANI
Fairmont Park	Not Given	Harris	ANI
Strawberry Park Tennis Complex	Not Given	Harris	ANI
El Lago City Park	Not Given	Harris	ANI
Hunter's Creek Hike & Bikeway	Not Given	Harris	ANI
Various Park Sites	Not Given	Harris	ANI
Flour Bluff Park	Not Given	Nueces	ANI
Speck Eakin Memorial Park	Not Given	San Patricio	ANI
Department of Interior, U.S. Fish and Wildlife Service			
Sidney Island	Not Given	Orange	ANI
Vingt-et-un Islands	Not Given	Galveston	ANI
Redfish Island	Not Given	Galveston	ANI
Snake Island	Not Given	Galveston	ANI
Second Chain of Islands, Ayres Bay	Not Given	Aransas	ANI
South Bird Island & North Bird Island	Not Given	Kleberg	ANI
North Deer Island & South Deer Island	Not Given	Galveston	ANI
Bird Island	Not Given	Brazoria	ANI
Pelican Island	Not Given	Calhoun	ANI
Harbor Island	Not Given	Nueces	ANI
Three Islands	Not Given	Cameron	ANI
Prairie Chicken Habitat, Moses Lake	Not Given	Galveston	ANI
North & South Jetties	Not Given	Galveston	ANI
Moses Lake Marshes	Not Given	Galveston	ANI
Mangrove Community	Not Given	Galveston	ANI
Whooping Crane Range	Not Given	Not Given	ANI
Wallisville Reservoir	Not Given	Chambers	ANI
General Services Administration			
Federal Building & Courthouse	5	Harris	Owned or Leased
Post Office & Courthouse	4	Galveston	Owned or Leased
GSA Plant Site	18	Calhoun	Owned or Leased
GSA Plant Site	96	San Patricio	Owned or Leased
GSA Plant Site	6	Harris	Owned or Leased
Also: 9 Federal Buildings with Tracts Less than 2 acres			
Health, Education, and Welfare			
U.S. PHS Hospital	Not Given	Galveston	Owned or Leased
Housing and Urban Development			
Forest Green Development	14	Harris	Owned or Leased
Space Center Memorial Hospital	8	Galveston	Owned or Leased
Columbia Park Development	3	Harris	Owned or Leased
Lyons Gardens	9	Harris	Owned or Leased
Town & Country Apts.	26	Harris	Owned or Leased
Holcomb Plaza Apts	13	Harris	Owned or Leased
Carriage Park	28	Harris	Owned or Leased
King Parkway Mobile Home Park	30	Harris	Owned or Leased
Maritime Administration			
Reserve Fleet Site	21	Jefferson	Owned or Leased
Spoil Disposal	716	Jefferson	Owned or Leased
National Aeronautics and Space Administration			
Barge Canal			
Support Facilities at Ellington	4	Harris	Owned or Leased
Air Force Base	Not Given	Harris	Owned or Leased
National Marine Fisheries Service (see also addendum B)			
Gulf Coast Fishery Center	4	Galveston	Owned or Leased
East Beach Lagoon Laboratory	207	Galveston	Owned or Leased
Port Aransas Laboratory	16	Nueces	Owned or Leased
U.S. Corps of Engineers			
Fort Point Resident Area	53	Galveston	Owned or Leased
Port Arthur Office	21	Jefferson	Owned or Leased
Corpus Field Office	2	Nueces	Owned or Leased
U.S. Geological Survey			
Oil & Gas Wells	100	San Patricio	Owned or Leased
Oil & Gas Wells	314	Galveston	Owned or Leased
Oil & Gas Wells	340	Galveston	Owned or Leased
Oil & Gas Wells	322	Galveston	Owned or Leased
Oil & Gas Wells	314	Galveston	Owned or Leased

NOTE: ANI=Areas of National Interest. This implies interest on the part of the respective agency but no ownership.

LEGEND

BUREAU OF OUTDOOR RECREATION

AREAS OF NATIONAL INTEREST
Local or regional recreational areas acquired or developed in part with monies from the Federal Land and Water Conservation Fund program
For additional areas, too small to appear on map or not precisely located by BOR, see addendum A

BUREAU OF RECLAMATION

OWNED LAND
Land purchased as part of the Palmetto Bend Reservoir project

AREAS OF NATIONAL INTEREST
Areas affected by proposed or existing irrigation, flood control, and drainage projects

FEDERAL AVIATION AGENCY

AREAS OF NATIONAL INTEREST
Airports
Dots indicate the location of airports too small to appear as defined areas on the map

FISH AND WILDLIFE SERVICE

OWNED LAND
National wildlife refuges

AREAS OF NATIONAL INTEREST
Proposed areas for new national wildlife refuges
All areas nominated by Texas Parks and Wildlife Dept. as areas of particular concern (unmapped here; see plates 4A and 4B)
Areas administered by the National Audobon Society as wildlife sanctuaries (for additional areas, too small to appear on this map, see addendum A)

Migratory bird habitat;* endangered species habitat for whooping crane, red wolf, peregrine falcon, southern bald eagle,* American alligator, and Attwater's prairie chicken
*See Plates 4A and 4B

GENERAL SERVICES ADMINISTRATION

Areas too small to map; see addendum A

HEALTH, EDUCATION AND WELFARE

Areas too small to map; see addendum A

HOUSING AND URBAN DEVELOPMENT

Areas too small to map see addendum A

INTERNATIONAL BOUNDARY AND WATER COMMISSION

EASEMENTS
Easements for construction of levees, floodways, and revetments

MARITIME ADMINISTRATION

Areas too small to map; See addendum A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OWNED LAND
Grounds and buildings of the Johnson Space Center

NATIONAL MARINE FISHERIES SERVICE

AREAS OF NATIONAL INTEREST, UNMAPPED
Most areas nominated by Texas Parks and Wildlife Dept. as areas of particular concern (see plates 4A and 4B, critical habitats matrix)
All coastal wetlands and shallow estuarine waters, especially those areas supporting submerged and tidal vegetation and shell reefs (see addendum B)

NATIONAL PARKS SERVICE

OWNED LAND
National parks

AREAS OF NATIONAL INTEREST
Areas included within a national park but not owned by the National Park Service at the present time
Areas on the boundary of a national park (unmapped)

NUCLEAR REGULATORY COMMISSION

AREAS OF NATIONAL INTEREST
Site of the south Texas nuclear power plant

U. S. AIR FORCE

OWNED AND LEASED LANDS
Air Force or Air National Guard bases and installations

U. S. ARMY

OWNED AND LEASED LANDS
U. S. Army Reserve bases and installations
Dot indicates location only and not areal extent of bases

U. S. COAST GUARD

OWNED LAND
Coast Guard bases and installations
Dot indicates location only and not areal extent of bases

U. S. CORPS OF ENGINEERS

OWNED LAND
Galveston Harbor and Ship Channel

AREAS OF NATIONAL INTEREST
Dredged channelways and areas important to navigation and flood control
Certain Dept. of Defense areas undergoing change in ownership.

U. S. NAVY

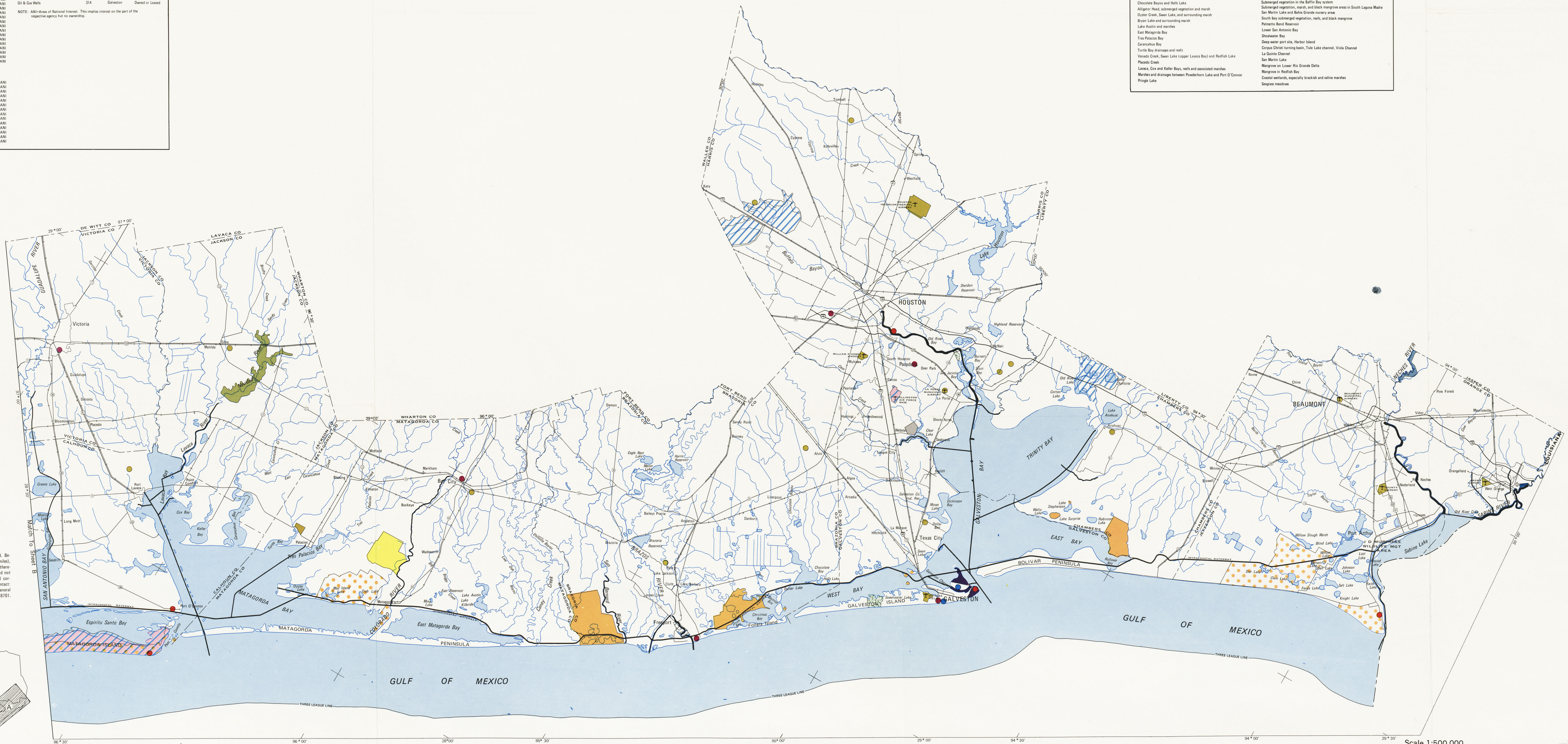
OWNED AND LEASED LAND
Naval bases and installations
Dots and squares show location only and not areal extent of bases

ADDENDUM B

UNMAPPED AREAS

Geographic areas of concern to NMFS in addition to those listed by TP & WD as critical habitat

- Keith's, Shell and Johnson Lakes and marsh complex
- Marshes and open water areas between Texas Pt. and Anahuac Refuge
- Long Point marsh area
- Moody Reef
- Double Bayou and adjacent marsh
- Fisher, Beasley and Dow Reefs
- Lower San Jacinto River
- San Jacinto Bay, Scott Bay, Lost Lake, Crystal Bay and Burnett Bay
- Red Bluff Reef
- Redfish Reef
- Dickinson Bay, Dickinson Bayou and marsh
- Moses Lake, Dollar Bay and surrounding marsh
- Dollar Reef and Half Moon Shoal
- Horseshoe Lake and marsh
- East Lagoon and associated marsh
- Marsh surrounding Swan Lake
- Jones Lake, Highland and Basford Bayou
- Offatts Bayou vegetated shoreline
- Confederate Reef
- North and South Deer Islands
- Carancahua Reef
- Chocolate Bayou and Halls Lake
- Alligator Head, submerged vegetation and marsh
- Oyster Creek, Swan Lake, and surrounding marsh
- Bryan Lake and surrounding marsh
- Lake Austin and marshes
- East Matagorda Bay
- Tres Palacios Bay
- Carancahua Bay
- Turtle Bay drainages and reefs
- Venado Creek, Swan Lake (Upper Lavaca Bay) and Redfish Lake
- Placedo Creek
- Lavaca, Cox and Keller Bays, reefs and associated marshes
- Marshes and drainages between Powderhorn Lake and Port O'Connor
- Pringle Lake
- San Antonio Bay system shoreline marshes, submerged vegetation and reefs
- Goff, Hog and Schwing Bayous
- Ayers and Sundown Bays, reefs and vegetated shorelines
- Mesquite Bay, vegetated shoreline and reefs
- Venson Slough and marsh
- Carlos Bay, vegetated areas and reefs
- St. Charles Bay, marsh and drainage, submerged vegetation and reefs
- Twin and Salt Creeks and Big Devil Bayou
- Copano Bay marsh, submerged vegetation, and reefs
- Newcom Point area, Swan Lake, Rattlesnake Point, and Egery Flats
- Lee side shoreline of St. Joseph Island
- Aransas Bay marsh, submerged vegetation, and reefs
- Ballow and Mud Island areas and Little Bay
- Redfish Bay marsh, submerged vegetation, and reefs
- Talley, Traylor, Hogg, Stedman, and Dagger Island areas
- Corpus Christi Bay marsh, submerged vegetation, and reefs
- Shamrock Cove and Oso Creek
- Nueces Bay marsh, submerged vegetation, and reefs
- Tule Lake area
- Packery Channel and Corpus Christi Pass and adjacent submerged vegetation
- West side of Mustang Island and submerged vegetation
- Submerged vegetation in the Baffin Bay system
- Submerged vegetation, marsh, and black mangrove areas in South Laguna Madre
- San Martin Lake and Bahia Grande nursery areas
- South Bay submerged vegetation, reefs, and black mangrove
- Palmetto Bend Reservoir
- Lower San Antonio Bay
- Shoalwater Bay
- Deep water port site, Harbor Island
- Corpus Christi turning basin, Tule Lake channel, Viola Channel
- La Quinta Channel
- San Martin Lake
- Mangrove on Lower Rio Grande Delta
- Mangrove in Redfish Bay
- Coastal wetlands, especially brackish and saline marshes
- Seagrass meadows



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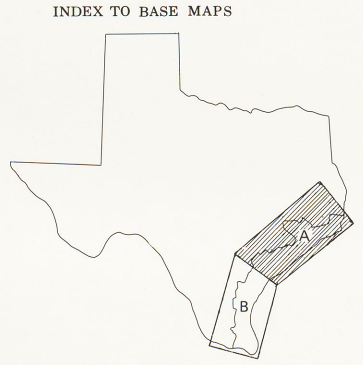

CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

FEDERAL LANDS AND AREAS OF NATIONAL INTEREST UPPER TEXAS COASTAL REGION 1976

Scale 1:500,000

10 0 10 20 30 40 Statute Miles

10 5 0 10 20 30 40 50 Kilometers

PLATE 2B

FEDERAL LANDS AND AREAS OF NATIONAL INTEREST

ADDENDUM A

UNMAPPED AREAS

These areas are either too small to appear at this scale or were not precisely located by the respective agencies.

AREA	ACREAGE	COUNTY	STATUS
Bureau of Outdoor Recreation			
Copano Bay St. Recreation Area	2	Aransas	ANI
T.V. Dunbar Memorial Park	68	Brazoria	ANI
Port Lavaca Fishing Pier Park	9	Calhoun	ANI
Airport Park & Playfield	9	Galveston	ANI
Airport General Park & Playfield	25	Galveston	ANI
Seawolf Park	9	Galveston	ANI
Carver Park	20	Galveston	ANI
Highland Bayou Community Park	1	Galveston	ANI
Stewenson Memorial Park	10	Galveston	ANI
Friendswood Parks Addition	8	Galveston	ANI
Houston Pocket Parks	2	Harris	ANI
EAP Creek Park	2108	Harris	ANI
Memorial Park	24	Harris	ANI
Fairmont Park	6	Harris	ANI
Lagrange Common Area	3	Harris	ANI
Agrican Community Parks	9	Harris	ANI
Pathway & Parkway	3	Harris	ANI
South Mossy Park	21	Harris	ANI
Nassau Bay City Park	13	Harris	ANI
Baytown Athletic Park	86	Harris	ANI
Springwood Park Pool	8	Harris	ANI
Fairfax Park	5	Harris	ANI
Lafferte Mini Bike Park	5	Harris	ANI
Lafferte Central Park	5	Harris	ANI
Trinity Gardens	5	Harris	ANI
Armand Bayou Regional Park	965	Harris	ANI
League of Women Voters Park	6	Harris	ANI
Avenue D Park	6	Harris	ANI
Webster City Park	8	Harris	ANI
Mcarter Park	4	Harris	ANI
Port Lavaca Public Pool	5	Calhoun	ANI
South Fishing Pier	1	Calhoun	ANI
Brownsville Park	15	Cameron	ANI
San Benito Recreation Park	87	Cameron	ANI
Public Boat Launching Ramp	20	Jefferson	ANI
Port Neches Park	60	Jefferson	ANI
Corp Reynolds Park	5	Jefferson	ANI
Beaumont Athletic Complex	123	Jefferson	ANI
Nederland Heritage Park	20	Jefferson	ANI
Bay City Swimming Pool Park	25	Matagorda	ANI
Orange County Park	446	Orange	ANI
Ridgemont Park	2	Orange	ANI
West Guth Park	88	Nueces	ANI
Port Aransas Park	122	Nueces	ANI
Portland City Park	13	Nueces	ANI
Bishop City Park	20	Nueces	ANI
Victoria Mem. Bridge	1	Victoria	ANI
Victoria Zoological Park	6	Victoria	ANI
Camp Wallace	631	Galveston	ANI
Kingsville Naval Air Station	534	Kleberg	ANI
Pelican Island	3	Galveston	ANI
Naval Reserve Center	1	Galveston	ANI
Galveston Harbor	331	Galveston	ANI
Navy Park Housing Project	4	Orange	ANI
Fort Crockett	2	Galveston	ANI
Port Arthur Hurricane Flood Control Project	121	Jefferson	ANI
Port Arthur Dike & Jetty Project	171	Nueces	ANI
Rockport Memorial Park	Not Given	Aransas	ANI
Brazos River Recreation Area	Not Given	Brazoria	ANI
Harris County Parks Acquisition	Not Given	Harris	ANI
Fairmont Park	Not Given	Harris	ANI
Strawberry Park Tennis Complex	Not Given	Harris	ANI
El Lago City Park	Not Given	Harris	ANI
Galveston Bike & Bikeway	Not Given	Harris	ANI
Various Park Sites	Not Given	Nueces	ANI
Flour Bluff Park	Not Given	Nueces	ANI
Seeck Eakin Memorial Park	Not Given	San Patricio	ANI
Department of Interior, U.S. Fish and Wildlife Service			
Sidney Island	Not Given	Orange	ANI
Big Hill Islands	Not Given	Galveston	ANI
Redfish Island	Not Given	Galveston	ANI
Snake Island	Not Given	Galveston	ANI
Second Chain of Islands, Ayres Bay	Not Given	Aransas	ANI
South Bird Island & North Bird Island	Not Given	Kleberg	ANI
North Deer Island & South Deer Island	Not Given	Galveston	ANI
Bird Island	Not Given	Brazoria	ANI
Pelican Island	Not Given	Calhoun	ANI
Harbor Island	Not Given	Nueces	ANI
Three Islands	Not Given	Cameron	ANI
Prairie Chicken Habitat, Moses Lake	Not Given	Galveston	ANI
North & South Jetties	Not Given	Galveston	ANI
Moses Lake Marshes	Not Given	Galveston	ANI
Mangrove Community	Not Given	Galveston	ANI
Whooping Crane Range	Not Given	Calhoun	ANI
Wallisville Reservoir	Not Given	Chambers	ANI
General Services Administration			
Federal Building & Courthouse	5	Harris	Owned or Leased
Post Office & Courthouse	4	Galveston	Owned or Leased
GSA Plant Site	18	Calhoun	Owned or Leased
GSA Plant Site	96	San Patricio	Owned or Leased
GSA Plant Site	6	Harris	Owned or Leased
Also: 9 Federal Buildings with Tracts Less than 2 acres			
Health, Education, and Welfare			
U.S. PHS Hospital	Not Given	Galveston	Owned or Leased
Housing and Urban Development			
Forest Green Development	14	Harris	Owned or Leased
Space Center Memorial Hospital	8	Galveston	Owned or Leased
Country Club Development	3	Harris	Owned or Leased
Lomo Gardens	9	Harris	Owned or Leased
Town & Country Apts.	18	Harris	Owned or Leased
Holcomb Plaza Apts.	13	Harris	Owned or Leased
Carriage Park	28	Harris	Owned or Leased
King Parkway Mobile Home Park	30	Harris	Owned or Leased
Maritime Administration			
Reserve Fleet Site	21	Jefferson	Owned or Leased
Spoil Disposal	716	Jefferson	Owned or Leased
National Aeronautics and Space Administration			
Barge Canal	4	Harris	Owned or Leased
Support Facilities at Ellington Air Force Base	Not Given	Harris	Owned or Leased
National Marine Fisheries Service (see also addendum B)			
Gulf Coast Fishery Center	4	Galveston	Owned or Leased
East Beach Lagoon Laboratory	207	Galveston	Owned or Leased
Port Aransas Laboratory	16	Nueces	Owned or Leased
U.S. Corps of Engineers			
Fort Point Resident Area	53	Galveston	Owned or Leased
Port Arthur Office	21	Jefferson	Owned or Leased
Corpus Field Office	2	Nueces	Owned or Leased
U.S. Geological Survey			
Oil & Gas Wells	100	San Patricio	Owned or Leased
Oil & Gas Wells	314	Galveston	Owned or Leased
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Oil & Gas Wells	314	Galveston	Owned or Leased

NOTE: ANI=Areas of National Interest. This implies interest on the part of the respective agency but no ownership.

BUREAU OF OUTDOOR RECREATION

AREAS OF NATIONAL INTEREST
Local or regional recreational areas acquired or developed in part with monies from the Federal Land and Water Conservation Fund program
For additional areas, too small to appear on map or not precisely located by BOR, see addendum A

BUREAU OF RECLAMATION

OWNED LAND
Land purchased as part of the Palmetto Bend Reservoir project

AREAS OF CONCERN
Areas affected by proposed or existing irrigation, flood control, and drainage projects

FEDERAL AVIATION AGENCY

AREAS OF NATIONAL INTEREST
Airports
Dots indicate the location of airports too small to appear as defined areas on the map

LEGEND

FISH AND WILDLIFE SERVICE

OWNED LAND
National wildlife refuges

AREAS OF NATIONAL INTEREST
Proposed areas for new national wildlife refuges
All areas nominated by Texas Parks and Wildlife Dept. as areas of particular concern (unmapped here; see plates 4A and 4B)
Areas administered by the National Audobon Society as wildlife sanctuaries
For additional areas, too small to appear on this map , see addendum A)

Migratory bird habitat*, endangered species habitat for whooping crane, red wolf, peregrine falcon, southern bald eagle, American alligator, and Attwater's prairie chicken
*See Plates 4A and 4B

GENERAL SERVICES ADMINISTRATION
Areas too small to map , see addendum A

HEALTH, EDUCATION AND WELFARE
Areas too small to map , see addendum A

HOUSING AND URBAN DEVELOPMENT
Areas too small to map, see addendum A

INTERNATIONAL BOUNDARY AND WATER COMMISSION

EASEMENTS
Easements for construction of levees, floodways, and revetments

MARITIME ADMINISTRATION
Areas too small to map- see addendum A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OWNED LAND
Grounds and buildings of the Johnson Space Center

NATIONAL MARINE FISHERIES SERVICE

AREAS OF NATIONAL INTEREST, UNMAPPED
Most areas nominated by Texas Parks and Wildlife Dept. as areas of particular concern (see plates 4A and 4B , critical habitats matrix)
All coastal wetlands and shallow estuarine waters, especially those areas supporting submerged and tidal vegetation and shell reefs (see addendum B)

NATIONAL PARKS SERVICE

OWNED LAND
National parks

AREAS OF NATIONAL INTEREST
Areas included within a national park but not owned by the National Park Service at the present time
Areas on the boundary of a national park (unmapped)

NUCLEAR REGULATORY COMMISSION

AREAS OF NATIONAL INTEREST
Site of the south Texas nuclear power plant

U.S. AIR FORCE

OWNED AND LEASED LANDS
Air Force or Air National Guard bases and installations

U.S. ARMY

OWNED AND LEASED LANDS
U.S. Army Reserve bases and installations
Dot indicates location only and not areal extent of bases

U.S. COAST GUARD

OWNED LAND
Coast Guard bases and installations
Dot indicates location only and not areal extent of bases

U.S. CORPS OF ENGINEERS

OWNED LAND
Galveston Harbor and Ship Channel

AREAS OF NATIONAL INTEREST
Dredged channelways and areas important to navigation and flood control
Carrion Dept. of Defense areas undergoing change in ownership

U.S. NAVY

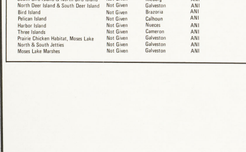
OWNED AND LEASED LAND
Naval bases and installations
Dots and squares show location only and not areal extent of bases

ADDENDUM B

UNMAPPED AREAS

Geographic areas of concern to NMFS in addition to those listed by TP & WD as critical habitat.

Keith's, Shell and Johnson Lakes and marsh complex
Marshes and open water areas between Texas Pt. and Anahuac Refuge
Long Point marsh area
Moody Reef
Double Bayou and adjacent marsh
Fisher, Beasley and Drew Reefs
Lower San Jacinto River
San Jacinto Bay, Scott Bay, Lost Lake, Crystal Bay and Burnett Bay
Red Bluff Reef
Redfish Reef
Dickinson Bay, Dickinson Bayou and marsh
Moses Lake, Dollar Bay and surrounding marsh
Dollar Reef and Half Moon Shoal
Hurwitzhse Lake and marsh
East Lagoon and associated marsh
Marsh surrounding Swan Lake
Jones Lake, Highland and Basford Bayou
Offatts Bayou vegetated shoreline
Confederate Reef
North and South Deer Islands
Caranchua Reef
Chocolate Bayou and Halls Lake
Alligator Head, submerged vegetation and marsh
Oyster Creek, Swan Lake, and surrounding marsh
Bryan Lake and surrounding marsh
Lake Austin and marshes
East Matagorda Bay
Trio Palacios Bay
Caranchua Bay
Turtle Bay drainages and reefs
Venado Creek, Swan Lake (Upper Lavaca Bay) and Redfish Lake
Placedo Creek
Lavaca, Cox and Keller Bays, reefs and associated marshes
Marshes and drainages between Powderhorn Lake and Port O'Connor
Pringle Lake
San Antonio Bay system shoreline marshes, submerged vegetation and reefs
Goff, Hog and Schwing Bayous
Ayers and Sundown Bays, reefs and vegetated shorelines
Mesquite Bay, vegetated shoreline and reefs
Venson Slough and marsh
Carlos Bay, vegetated areas and reefs
St. Charles Bay, marsh and drainage, submerged vegetation and reefs
Twin and Salt Creeks and Big Shell Bayou
Copano Bay marsh, submerged vegetation, and reefs
Newcom Point area, Swan Lake, Rattlesnake Point, and Egery Flats
Lee side shoreline of St. Joseph Island
Aransas Bay marsh, submerged vegetation, and reefs
Bellow and Mud Island areas and Little Bay
Redfish Bay marsh, submerged vegetation, and reefs
Talley, Traylor, Hogg, Stedman, and Dagger Island areas
Corpus Christi Bay marsh, submerged vegetation, and reefs
Shamrock Cove and Oso Creek
Nueces Bay marsh, submerged vegetation, and reefs
Tule Lake area
Packery Channel and Corpus Christi Pass and adjacent submerged vegetation
West side of Mustang Island and submerged vegetation
Submerged vegetation in the Baffin Bay system
Submerged vegetation, marsh, and black mangrove areas in South Laguna Madre
San Martin Lake and Bahia Grande nursery areas
South Bay submerged vegetation, reefs, and black mangrove
Palmetto Bend Reservoir
Lower San Antonio Bay
Shoalwater Bay
Deep water port site, Harbor Island
Corpus Christi turning basin, Tule Lake channel, Viola Channel
La Quinta Channel
San Martin Lake
Mangroves on Lower Rio Grande Delta
Mangroves in Redfish Bay
Coastal wetlands, especially brackish and saline marshes
Seagrass meadows



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CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

FEDERAL LANDS AND AREAS OF NATIONAL INTEREST
LOWER TEXAS COASTAL REGION 1976

Scale 1:500,000
10 0 10 20 30 40 Statute Miles
10 5 0 10 20 30 40 50 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

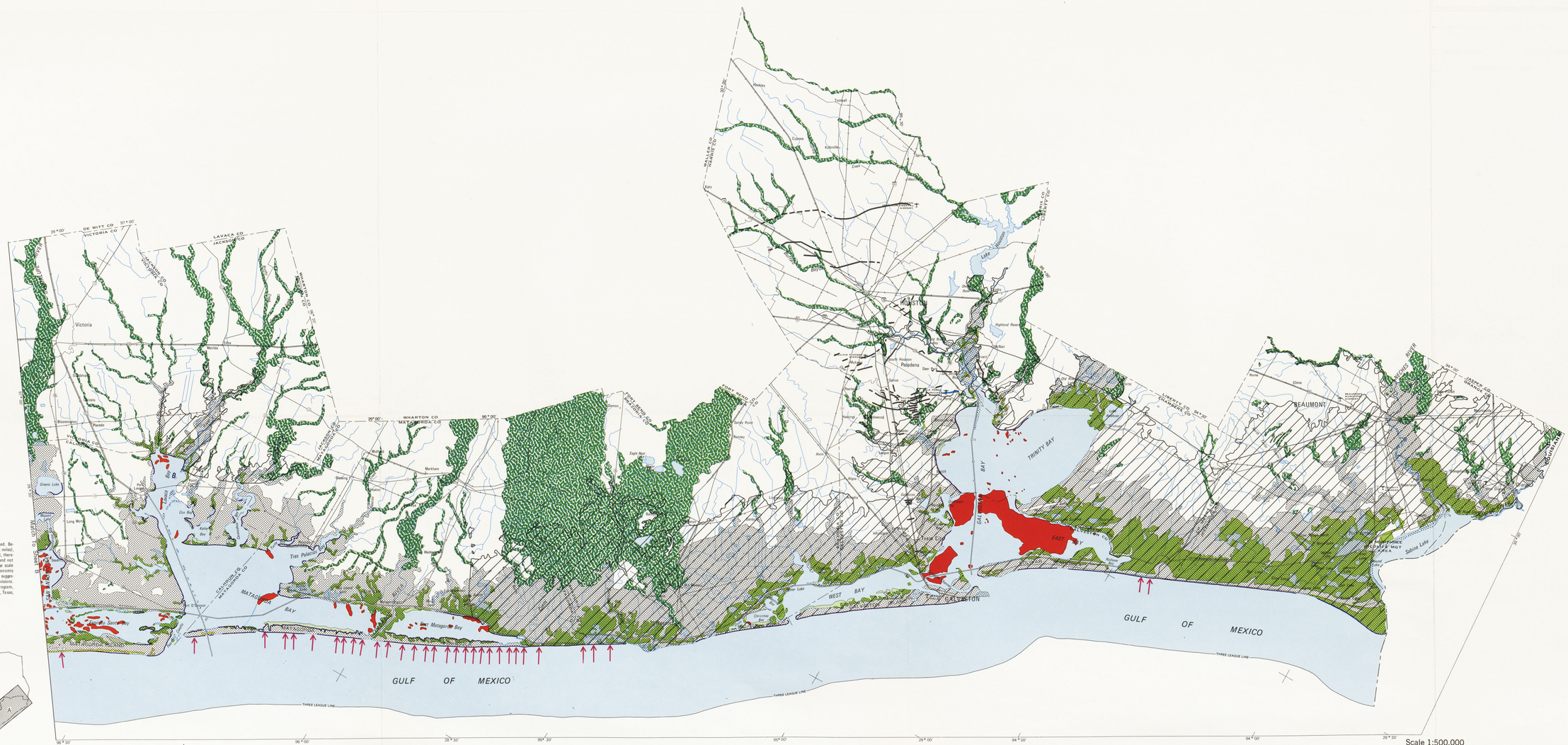
LEGEND
AREAS OF PARTICULAR STATE CONCERN AS NOMINATED BY THE BUREAU OF ECONOMIC GEOLOGY

- OYSTER REEF AREAS
  Reefs, reef flank, and margin (many extensively dredged)
- GRASSFLATS
  Grassflats and hypersaline grassflats
- TIDAL MARSH AND TIDAL CREEKS
  Salt-water marsh, brackish marsh, and brackish-to-fresh-water marsh; small creeks and streams that are tidally influenced
- FORE-ISLAND DUNES
  Fore-island dune ridge and fore-island blowout dunes
- HURRICANE TIDAL FLOODING
  Areas flooded by salt-water during hurricane Beulah or Carla
- FAULTS
  Active or potentially active surface faults (dashed where inferred)
- EROSIONAL SHORELINES
  Variable rates or amounts (1-10 feet per year)
- ACTIVE FLOODPLAINS AND POORLY DRAINED AREAS
  Areas flooded by hurricane Beulah or Carla rainfall; areas where depositional pattern or topography indicates potential flooding hazard
- WASHOVER CHANNELS
  Active or potential hurricane washover channels
- LAND SUBSIDENCE IN AREAS BELOW 25 FEET MSL
  Variable amounts of subsidence (from .2 to more than 5 feet)
- ACTIVE DUNES AND BLOWOUTS
  Back-island dunes, coppice dunes, inland dunes, barchan dunes, and clay-sand dunes (on mainland)

PLATE 3A

AREAS OF PARTICULAR STATE CONCERN

AS NOMINATED BY THE BUREAU OF ECONOMIC GEOLOGY



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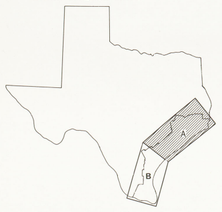


CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

AREAS OF PARTICULAR STATE CONCERN
UPPER TEXAS COASTAL REGION 1976

Scale 1:500,000

10 0 10 20 30 40 Statute Miles

10 5 0 10 20 30 40 50 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

LEGEND
AREAS OF PARTICULAR STATE CONCERN AS NOMINATED BY THE BUREAU OF ECONOMIC GEOLOGY

OYSTER REEF AREAS
Reefs, reef flank, and margin (many extensively dredged)

GRASSFLATS
Grassflats and hypersaline grassflats

TIDAL MARSH AND TIDAL CREEKS
Salt-water marsh, brackish marsh, and brackish-to-fresh-water marsh; small creeks and streams that are tidally influenced

FORE-ISLAND DUNES
Fore-island dune ridge and fore-island blowout dunes

HURRICANE TIDAL FLOODING
Areas flooded by salt-water during hurricane Beulah or Carla

FAULTS
Active or potentially active surface faults (dashed where inferred)

EROSIONAL SHORELINES
Variable rates or amounts (1-10 feet per year)

ACTIVE FLOODPLAINS AND POORLY DRAINED AREAS
Areas flooded by hurricane Beulah or Carla rainfall; areas where depositional pattern or topography indicates potential flooding hazard

WASHOVER CHANNELS
Active or potential hurricane washover channels

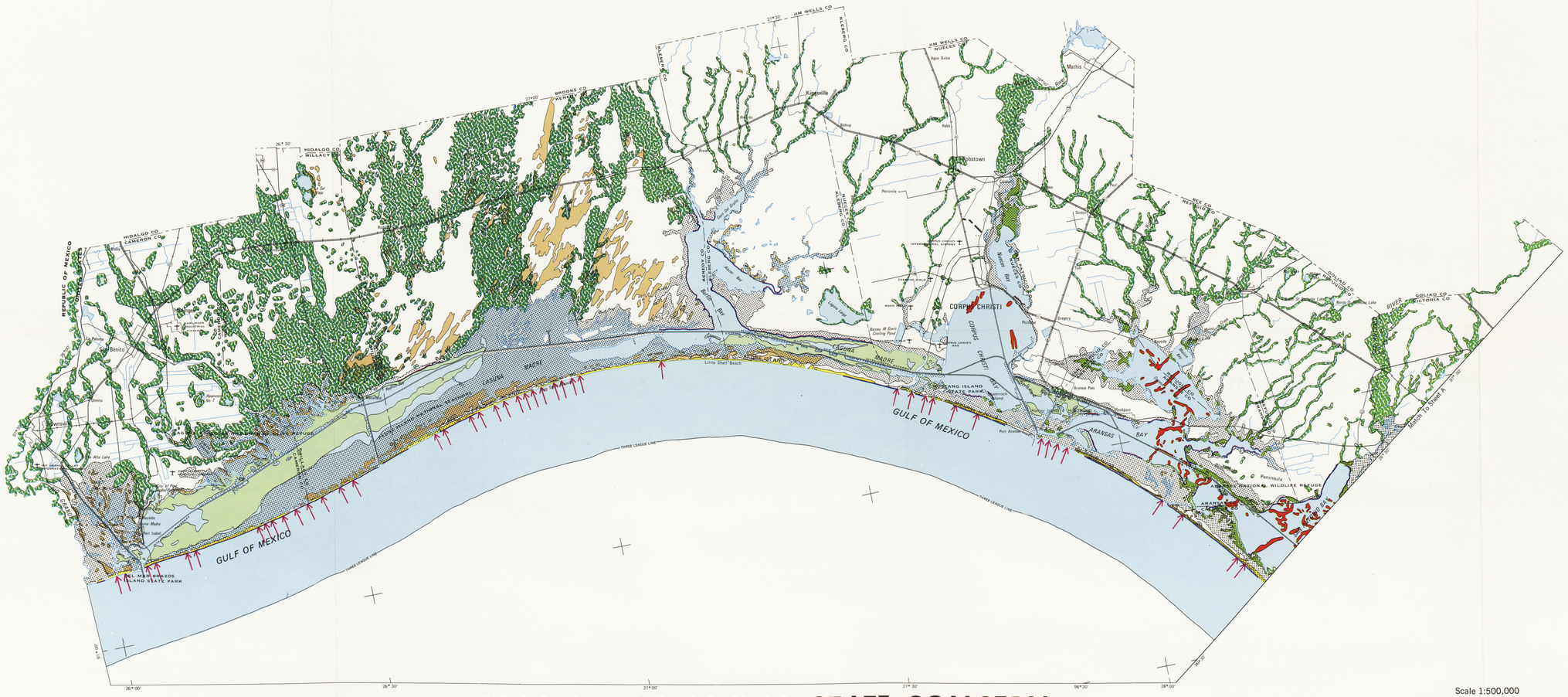
LAND SUBSIDENCE IN AREAS BELOW 25 FEET MSL
Variable amounts of subsidence (from .2 to more than 5 feet)

ACTIVE DUNES AND BLOWOUTS
Back-island dunes, coppice dunes, inland dunes, barchan dunes, and clay-sand dunes (on mainland)

PLATE 3B

AREAS OF PARTICULAR STATE CONCERN

AS NOMINATED BY THE BUREAU OF ECONOMIC GEOLOGY



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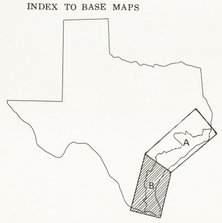


CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

AREAS OF PARTICULAR STATE CONCERN
LOWER TEXAS COASTAL REGION 1976

Scale 1:500,000
10 0 10 20 30 40 Statute Miles
10 5 0 10 20 30 40 50 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM
PLATE 4A
AREAS OF PARTICULAR STATE CONCERN
AS NOMINATED BY THE TEXAS PARKS AND WILDLIFE DEPARTMENT

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN — CRITICAL HABITATS NOMINATED BY TEXAS PARKS AND WILDLIFE DEPARTMENT

(Columns 1–25)

Justification	1 Neches River streambottom hardwoods	2 Sabine-Neches marshes	3 Sabine Lake, Pleasure Island shore	4 Brackish marshes near ICWW in Jefferson County	5 Marshes near Anahuac National Wildlife Refuge	6 Rollover Bay	7 Rollover Pass	8 Eastern part of East Bay	9 Robinson's Lake	10 Lake Surprise	11 Bolivar Flats	12 Elmgrove Point, East Bay	13 Hanna Reef	14 Trinity Bay, especially margin	15 Trinity River delta and marshes	16 Trinity River streambottom hardwoods *	17 Cedar Bayou and Tabb's Bay	18 Clear Lake, Mud Lake, Taylor Lake, Clear Creek	19 Redfish Bar oyster reefs	20 Texas City Dike and levee	21 Swan Lake	22 Bolivar Roads	23 West Bay shoreline	24 Carancahua L., Green's L., and marsh	25 Chocolate Bayou, Hall's Bayou
Area of National Interest (green dot)		●			●	●	●	●	●			●	●	●	●		●	●	●	●	●		●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●	●		●	●				●	●			●		●	●			●		●			●	●
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●		●	●	●		●	●	●		●	●	●	●	●	●	●	●		●		●	●	●
Areas of substantial recreational value or opportunity.			●				●				●		●	●	●				●	●		●	●		●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.																		●		●					●
Areas of unique geologic or topographic significance to industrial or commercial development.																									
Areas of urban concentration where shoreline utilization and water uses are highly competitive.																		●		●			●		
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.	●															●									
Areas needed to protect, maintain, or replenish coastal lands or resources.		●		●			●	●				●	●	●	●				●		●	●		●	●
Shrimp nursery.		●		●	●	●		●	●			●		●	●		●	●			●		●	●	●
Finfish nursery.		●		●	●	●		●	●			●		●	●		●	●			●		●	●	●
Blue crab nursery.		●		●	●	●		●	●			●		●	●		●	●			●		●	●	●
Oyster reef.																			●				●	●	●
Grass flats.																							●		●
Marshes.		●		●	●				●	●		●			●		●	●			●		●	●	●
Spawning grounds.																							●		●
Water exchange passes																						●			
Freshwater input.															●	●	●	●							●
Water fowl areas.	●	●	●	●	●			●	●	●		●		●	●	●					●		●	●	●
Endangered species.	●	●		●											●	●		●	●		●				●
Fish-eating bird rookeries.		●	●	●										●	●				●	●					
Muskrat, otter, and nutria habitats.				●	●				●			●			●										●
Non-game birds, watching		●	●		●	●		●			●				●		●	●	●	●			●		

(Columns 26–50)

Justification	26 San Luis Pass	27 Christmas, Drum, Bastrop Bays and bayou; Mud Is.	28 Lower San Bernard R., Cedar and nearby lakes	29 Chinquapin and Caney Crk. resort area	30 Lakes and watersheds draining to E. Matagorda Bay	31 Eastern Colorado R. Delta	32 Matagorda Peninsula and bay margin	33 Reefs in Matagorda Bay arm	34 Oyster L. to Freshwater L. - sloughs and marshes	35 Colorado River-area of tidal influence	36 Tres Palacios R., marshes, and drainage areas	37 Carancahua Crk., Bay, drainage areas, shoreline	38 Garcitas Crk., Lavaca R., Chocolate Bay and marsh	39 Port Lavaca-Point Comfort area	40 Spoil islands along Matagorda channel	41 Guadalupe R. Delta, Green L., bottomlands	42 Hynes, Guadalupe, upper San Antonio Bays	43 Shoalwater Bay	44 Espiritu Santo Bay	45 Powderhorn Lake	46 Pass Cavallo	47 Area west of Pass Cavallo	48 Matagorda Is., especially marsh	49 Oyster reefs in San Antonio Bay	50 Cedar Bayou
Area of National Interest (green dot)		●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●	●	●					●							●	●			●		●			●	
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.		●	●	●	●	●	●		●	●	●	●	●	●		●	●	●	●	●		●	●		
Areas of substantial recreational value or opportunity.	●	●		●	●					●			●								●	●	●	●	●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.				●	●					●		●		●						●					
Areas of unique geologic or topographic significance to industrial or commercial development.										●	●														
Areas of urban concentration where shoreline utilization and water uses are highly competitive.				●						●															
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.										●															
Areas needed to protect, maintain, or replenish coastal lands or resources.		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Shrimp nursery.		●	●		●	●	●		●	●	●	●	●	●		●	●	●	●	●		●	●		
Finfish nursery.		●	●		●	●	●		●	●	●	●	●	●		●	●	●	●	●		●	●		
Blue crab nursery.		●	●		●	●	●		●	●	●	●	●	●		●	●	●	●	●		●	●		
Oyster reef.		●	●				●	●	●			●					●		●					●	
Grass flats.		●					●	●										●	●			●	●		
Marshes.		●	●		●	●	●		●		●	●	●	●		●	●		●	●		●	●		
Spawning grounds.		●	●				●	●			●	●		●		●	●	●	●			●	●		
Water exchange passes	●																				●	●			●
Freshwater input.		●	●	●	●	●	●			●	●	●	●			●									
Water fowl areas.		●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	●		●	●		
Endangered species.		●					●									●	●						●		
Fish-eating bird rookeries.		●			●		●								●	●	●						●		
Muskrat, otter, and nutria habitats.																									
Non-game birds, watching	●	●								●			●		●	●		●		●		●	●		

(Columns 51–75)

Justification	51 St. Joseph's Is., grassflats, marsh	52 Oyster reefs - Ayres to Aransas Bays	53 Upper reach of St. Charles Bay	54 Lamar Peninsula	55 Copano Creek and Copano Cove	56 Copano Bay	57 Lower Mission River and Mission Bay	58 Major oyster reefs in Copano Bay	59 Lower Aransas River and Chiltipin Creek	60 Port Bay	61 Redfish Bay, Harbor Is., and mangroves	62 Aransas Pass	63 Mustang Island bayside grassflats and marshes	64 Fish pass on Mustang Island	65 Pelican Island	66 Ingleside Cove	67 Northeast corner of Nueces Bay, reef areas	68 North shore of Nueces Bay	69 Nueces Bay	70 Nueces River and upper Nueces Bay marshes	71 Oyster reefs in Corpus Christi Bay	72 Oso Bay	73 Water exchange area through Kennedy Causeway	74 Upper Laguna Madre	75 Middle Laguna Madre, Baffin Bay margin
Area of National Interest (green dot)		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●	●		●	●			●			●				●		●				●				
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●		●		●	●	●		●	●	●		●			●		●	●	●		●		●	●
Areas of substantial recreational value or opportunity.	●		●	●		●					●	●	●	●							●			●	●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.																●						●			
Areas of unique geologic or topographic significance to industrial or commercial development.																●									
Areas of urban concentration where shoreline utilization and water uses are highly competitive.																									
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.																									
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Shrimp nursery.	●		●		●	●	●		●	●	●		●					●	●	●		●		●	●
Finfish nursery.	●		●		●	●	●		●	●	●		●			●		●	●	●		●		●	●
Blue crab nursery.	●		●		●	●	●		●	●	●		●					●	●	●		●			
Oyster reef.		●				●		●									●		●		●				
Grass flats.	●			●	●	●				●	●		●			●		●						●	●
Marshes.	●					●	●		●	●	●		●							●		●		●	
Spawning grounds.	●										●								●					●	●
Water exchange passes												●		●									●		
Freshwater input.					●		●		●											●					
Water fowl areas.	●		●		●	●	●			●	●		●		●		●			●		●		●	●
Endangered species.	●		●								●														
Fish-eating bird rookeries.					●					●	●				●		●			●				●	●
Muskrat, otter, and nutria habitats.																									
Non-game birds, watching			●	●	●	●	●		●	●	●	●	●				●			●		●		●	●

(Columns 76–98)

Justification	76 Baffin Bay, Laguna Madre - deeper areas	77 Nine Mile Hole	78 Four Mile Slough to Arroyo Colorado	79 Creek west of Four Mile Slough	80 Natural drainage area from Arroyo Colorado	81 Arroyo Colorado to Port Harlingen	82 Cayo Atascosa	83 Mud Hole	84 Gabrielson Is. to Caballo Is.	85 Laguna Vista Cove	86 Bay side of southern tip of Padre Island	87 Brazos Santiago Pass	88 Mexiquita Flats	89 South Bay	90 Brownsville Ship Channel	91 Rio Grande to Brownsville	Lee side of Padre Island *	Dunes on Padre, Mustang, St. Joseph's Is. *	Marshes, rice fields, coastal prairies not on map *	USFWS land tracts - Hidalgo County *	Rookeries	Waterfowl habitat	Eagle habitat
Area of National Interest (green dot)	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●							
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.							●				●	●	●	●				●		●	●		
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●		●	●	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	
Areas of substantial recreational value or opportunity.	●	●	●			●			●		●	●			●	●		●				●	
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.											●												
Areas of unique geologic or topographic significance to industrial or commercial development.																		●					
Areas of urban concentration where shoreline utilization and water uses are highly competitive.																							
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.																		●					
Areas needed to protect, maintain, or replenish coastal lands or resources.	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●					
Shrimp nursery.			●	●	●	●	●	●	●				●	●	●	●							
Finfish nursery.			●			●	●		●	●	●		●	●	●								
Blue crab nursery.			●			●	●		●	●	●		●	●									
Oyster reef.														●									
Grass flats.			●				●		●		●						●						
Marshes.																			●			●	
Spawning grounds.			●								●												
Water exchange passes		●										●											
Freshwater input.				●	●	●										●							
Water fowl areas.			●				●		●		●					●	●		●		●	●	
Endangered species.																			●	●	●		●
Fish-eating bird rookeries.														●							●	●	●
Muskrat, otter, and nutria habitats.																							
Non-game birds, watching									●			●		●						●	●	●	●

● Areas of National Interest nominated by National Marine Fisheries Service (green dots)
* Areas treated textually, not located on map

AREAS OF PARTICULAR CONCERN
RECREATIONAL, HISTORICAL, AND WILDLIFE MANAGEMENT AREAS

STATE PARKS
- S1 - Sea Rim
- S2 - Galveston Island
- S3 - Mustang Island

STATE RECREATION AREAS
- S5 - Bryan Beach
- S6 - Goose Island
- S7 - Lake Corpus Christi
- S8 - Brazos Island

STATE HISTORICAL PARKS
- S9 - Sabine Pass Battleground
- S10 - San Jacinto Battleground
- S11 - Varner-Hogg Plantation

STATE HISTORICAL SITES
- S13 - Lipantitlan

STATE HISTORICAL STRUCTURES
- S15 - Port Isabel Lighthouse

STATE FISHING PIERS
- S16 - Port Lavaca
- S17 - Copano Bay
- S18 - Queen Isabella

STATE MANAGEMENT AREAS
- S19 - J. D. Murphree Wildlife Management Area
- S20 - Sheldon Wildlife Management Area
- S21 - Las Palomas Wildlife Management Area
- S22 - Swan Point Fisherman Access Area

NATIONAL PARKS, PRESERVES, REFUGES
- N1 - Padre Island National Seashore
- N2 - Laguna Atascosa National Wildlife Refuge
- N3 - Aransas National Wildlife Refuge
- N4 - San Bernard National Wildlife Refuge
- N5 - Brazoria National Wildlife Refuge
- N6 - Anahuac National Wildlife Refuge

URBAN NATURAL AREAS *
- U1 - Armand Bayou
- U4 - Live Oak Peninsula
- U6 - Prairie Chicken Habitat
- U9 - Upper Buffalo Bayou
- U10 - Pine Island Bayou
- U18 - Lower Sabine Cypress Swamp
- U19 - Banks of Oso Creek
- U25 - Brownsville Whitewing Dove Habitat
- U27 - Bird Flats

RURAL NATURAL AREAS *
- R2 - Loblolly Unit North Extension **
- R6 - Matagorda Island
- R7 - Sandylands Ponds * *
- R8 - Pine Island Bayou
- R11 - Smartt Fire Tower Savannah * *
- R14 - Smith's Woods
- R21 - Marysee Prairie * *
- R23 - Salt Creek Ranch * *
- R46 - Baffin Bay
- R51 - Texas Point Salt Marsh
- R55 - Red Wolf Marshes (see text)
- R56 - Black Rail Salt Marsh
- R57 - Mustang Island Shores
- R59 - Rosehill Pines * *

TRAILS

Existing Trails for a Potential Statewide System ***
- T2 - Galveston Island State Park Trail
- T3 - Padre Island National Seashore Grasslands Trail
- T4 - Aransas National Wildlife Refuge Nature Trails
- T5 - Buffalo Bayou Hike and Bike Trail

AREAS HAVING POTENTIAL FOR FUTURE TRAIL DEVELOPMENT ***
- T8 - Orange County Park
- T9 - Coleto Creek
- T12 - Padre Island National Seashore
- T13 - Lake Houston to Sheldon Reservoir
- T14 - Wild Cow Island

WATERWAYS FOR A POTENTIAL STATEWIDE SYSTEM****
- SW14 - Neches River Scenic Waterway
- SW20 - Sabine River Scenic Waterway
- SW21 - San Bernard River Scenic Waterway

*From: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department

**Not located on map - see Texas Outdoor Recreation Plan

***From: Texas Trailways, A Feasibility Report on a System of Trails in Texas, Texas Parks and Wildlife Department

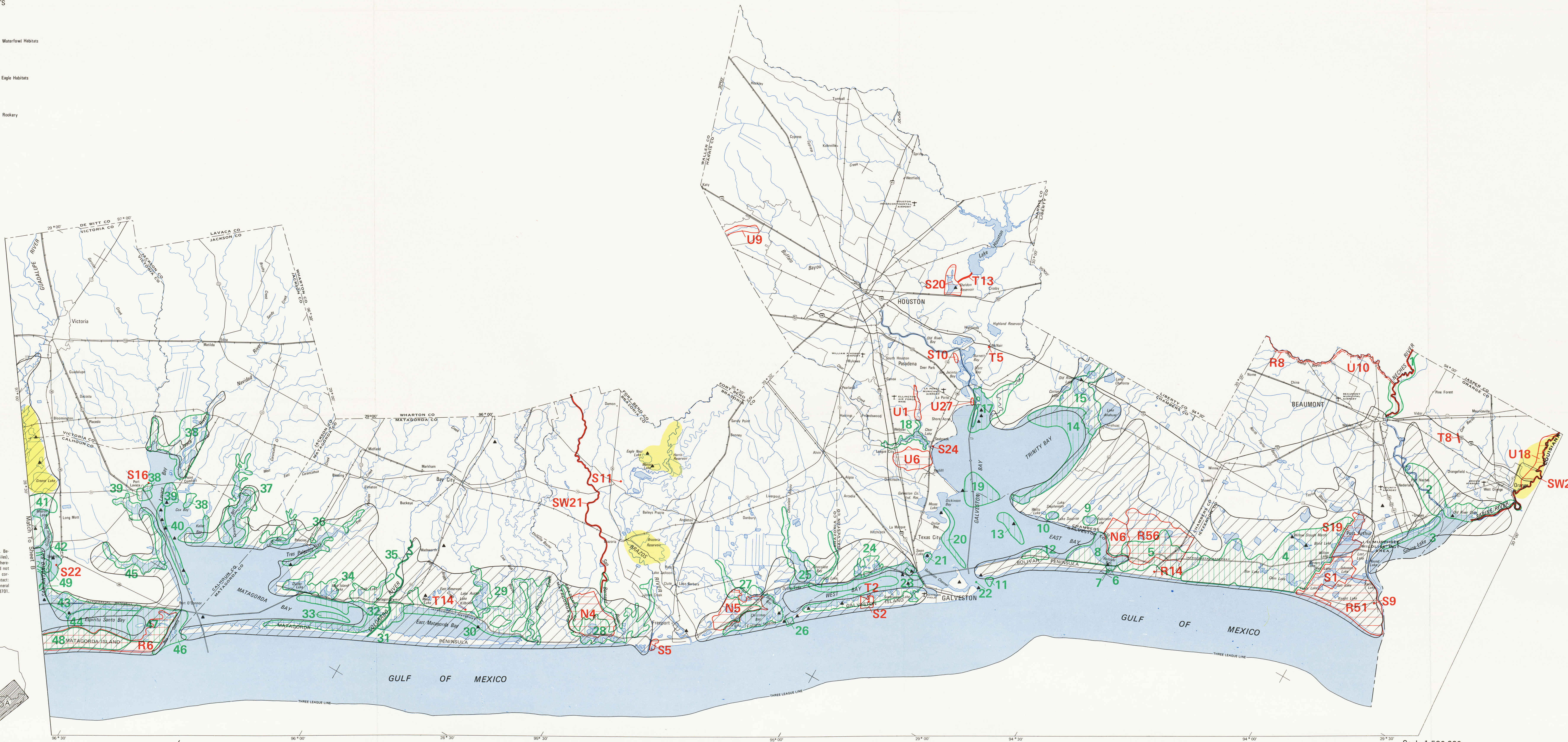
***From: Texas Waterways, A Feasibility Report on a System of Wild, Scenic and Recreational Waterways in Texas, Texas Parks and Wildlife Department

Note: Map units are not numbered sequentially because they are taken from a previously published map (General Land Office of Texas, 1975)

LEGEND

AREAS OF PARTICULAR CONCERN

- 29 — CRITICAL HABITATS
- NATURAL AREAS - Waterfowl Habitats
- NATURAL AREAS - Eagle Habitats
- NATURAL AREAS - Rookery
- S13 — OTHER AREAS



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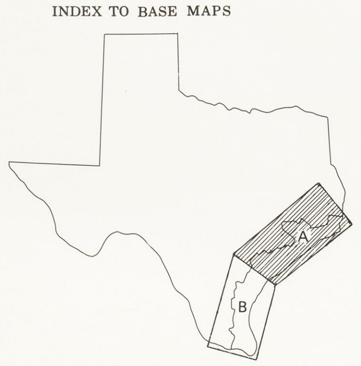

Scale 1:500,000

10 0 10 20 30 40 Statute Miles

10 5 0 10 20 30 40 50 Kilometers

AREAS OF PARTICULAR STATE CONCERN
UPPER TEXAS COASTAL REGION 1976

CARTOGRAPHIC PRESENTATION AND PRINTING BY
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SAN ANTONIO, TEXAS 78216

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 4B
AREAS OF PARTICULAR STATE CONCERN
AS NOMINATED BY THE TEXAS PARKS AND WILDLIFE DEPARTMENT

CRITICAL HABITATS NOMINATED BY TEXAS PARKS AND WILDLIFE DEPARTMENT

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	1 Neches River streambottom hardwoods	2 Sabine-Neches marshes	3 Sabine Lake, Pleasure Island shore	4 Brackish marshes near ICWW in Jefferson County	5 Marshes near Anahuac National Wildlife Refuge	6 Rollover Bay	7 Rollover Pass	8 Eastern part of East Bay	9 Robinson's Lake	10 Lake Surprise	11 Bolivar Flats	12 Elmgrove Point, East Bay	13 Hanna Reef	14 Trinity Bay, especially margin
Areas of National Interest (green ●)		●			●	●	●	●	●			●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●	●		●	●				●	●			●	
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●		●	●	●		●	●	●		●	●	●
Areas of substantial recreational value or opportunity.			●				●				●		●	●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.														
Areas of unique geologic or topographic significance to industrial or commercial development.														
Areas of urban concentration where shoreline utilization and water uses are highly competitive.														
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.	●													
Areas needed to protect, maintain, or replenish coastal lands or resources.		●		●			●	●				●	●	●
Shrimp nursery.		●		●	●	●		●	●			●		●
Finfish nursery.		●		●	●	●		●	●			●		●
Blue crab nursery		●		●	●	●		●	●			●		●
Oyster reef														
Grass flats.														
Marshes.		●		●	●				●	●		●		
Spawning grounds.														
Water exchange passes.														
Freshwater input.														
Water fowl areas.	●	●	●	●	●			●	●	●		●		●
Endangered species.	●	●		●										
Fish-eating bird rookeries.		●	●	●										●
Muskrat, otter, and nutria habitats.				●	●				●			●		
Non-game birds, watching.		●	●		●	●		●			●			

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	15 Trinity River delta and marshes	16 Trinity River streambottom hardwoods ✲	17 Cedar Bayou and Tabb's Bay	18 Clear Lake, Mud Lake, Taylor Lake, Clear Creek	19 Redfish Bar oyster reefs	20 Texas City Dike and levee	21 Swan Lake	22 Bolivar Roads	23 West Bay shoreline	24 Carancahua L., Green's L., and marsh	25 Chocolate Bayou, Hall's Bayou	26 San Luis Pass	27 Christmas, Drum, Bastrop Bays and bayou; Mud Is.	28 Lower San Bernard R., Cedar and nearby lakes
Areas of National Interest (green ●)	●		●	●	●	●	●		●	●	●		●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●	●			●		●			●	●	●	●	●
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●	●	●	●		●		●	●	●		●	●
Areas of substantial recreational value or opportunity.	●				●	●		●	●		●	●	●	
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.				●		●					●			
Areas of unique geologic or topographic significance to industrial or commercial development.														
Areas of urban concentration where shoreline utilization and water uses are highly competitive.				●		●			●					
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.		●												
Areas needed to protect, maintain, or replenish coastal lands or resources.	●				●		●	●		●	●		●	●
Shrimp nursery.	●		●	●			●		●	●	●		●	●
Finfish nursery.	●		●	●			●		●	●	●		●	●
Blue crab nursery	●		●	●			●		●	●	●		●	●
Oyster reef					●				●	●	●		●	●
Grass flats.									●		●		●	
Marshes.	●		●	●			●		●	●	●		●	●
Spawning grounds.									●		●		●	●
Water exchange passes.								●				●		
Freshwater input.	●	●	●	●							●		●	●
Water fowl areas.	●	●					●		●	●	●		●	●
Endangered species.	●	●		●	●		●				●		●	
Fish-eating bird rookeries.	●				●	●							●	
Muskrat, otter, and nutria habitats.	●										●			
Non-game birds, watching.	●		●	●	●	●			●			●	●	

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	29 Chinquapin and Caney Crk. resort area	30 Lakes and watersheds draining to E. Matagorda Bay	31 Eastern Colorado R. Delta	32 Matagorda Peninsula and bay margin	33 Reefs in Matagorda Bay arm	34 Oyster L. to Freshwater L. - sloughs and marshes	35 Colorado River area of tidal influence	36 Tres Palacios R., marshes, and drainage areas	37 Carancahua Crk., Bay, drainage areas, shoreline	38 Garcitas Crk., Lavaca R., Chocolate Bay and marsh	39 Port Lavaca-Point Comfort area	40 Spoil islands along Matagorda channel	41 Guadalupe R. Delta, Green L., bottomlands	42 Hynes, Guadalupe, upper San Antonio Bays
Areas of National Interest (green ●)	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.					●							●	●	
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●	●	●		●	●	●	●	●	●		●	●
Areas of substantial recreational value or opportunity.	●	●					●			●				
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.	●	●					●		●		●			
Areas of unique geologic or topographic significance to industrial or commercial development.							●	●						
Areas of urban concentration where shoreline utilization and water uses are highly competitive.	●						●							
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.							●							
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Shrimp nursery.		●	●	●		●	●	●	●	●	●		●	●
Finfish nursery.		●	●	●		●	●	●	●	●	●		●	●
Blue crab nursery		●	●	●		●	●	●	●	●	●		●	●
Oyster reef				●	●	●			●					●
Grass flats.				●	●									
Marshes.		●	●	●		●		●	●	●	●		●	●
Spawning grounds.				●	●			●	●		●		●	●
Water exchange passes.														
Freshwater input.	●	●	●	●			●	●	●	●			●	
Water fowl areas.	●	●	●	●		●	●	●	●	●		●	●	●
Endangered species.				●									●	●
Fish-eating bird rookeries.		●		●								●	●	●
Muskrat, otter, and nutria habitats.														
Non-game birds, watching.							●			●		●	●	

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	43 Shoalwater Bay	44 Espiritu Santo Bay	45 Powderhorn Lake	46 Pass Cavallo	47 Area west of Pass Cavallo	48 Matagorda Is., especially marsh	49 Oyster reefs in San Antonio Bay	50 Cedar Bayou	51 St. Joseph's Is., grassflats, marsh	52 Oyster reefs - Ayres to Aransas Bays	53 Upper reach of St. Charles Bay	54 Lamar Peninsula	55 Copano Creek and Copano Cove	56 Copano Bay
Areas of National Interest (green ●)	●	●	●	●	●	●		●		●	●	●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.		●		●			●		●	●		●	●	
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●	●		●	●			●		●		●	●
Areas of substantial recreational value or opportunity.				●	●	●	●	●	●		●	●		●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.			●											
Areas of unique geologic or topographic significance to industrial or commercial development.														
Areas of urban concentration where shoreline utilization and water uses are highly competitive.														
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.														
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●	●	●	●	●	●	●	●	●		●	●
Shrimp nursery.	●	●	●		●	●			●		●		●	●
Finfish nursery.	●	●	●		●	●			●		●		●	●
Blue crab nursery	●	●	●		●	●			●		●		●	●
Oyster reef		●					●			●				●
Grass flats.	●	●			●	●			●			●	●	●
Marshes.		●	●		●	●			●					●
Spawning grounds.	●	●			●	●			●					
Water exchange passes.				●	●			●						
Freshwater input.													●	
Water fowl areas.	●	●	●		●	●			●		●		●	●
Endangered species.						●			●		●			
Fish-eating bird rookeries.						●							●	
Muskrat, otter, and nutria habitats.														
Non-game birds, watching.	●		●		●	●					●	●	●	●

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	57 Lower Mission River and Mission Bay	58 Major oyster reefs in Copano Bay	59 Lower Aransas River and Chiltipin Creek	60 Port Bay	61 Redfish Bay, Harbor Is., and mangroves	62 Aransas Pass	63 Mustang Island bayside grassflats and marshes	64 Fish pass on Mustang Island	65 Pelican Island	66 Ingleside Cove	67 Northeast corner of Nueces Bay, reef areas	68 North shore of Nueces Bay	69 Nueces Bay	70 Nueces River and upper Nueces Bay marshes
Areas of National Interest (green ●)	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.		●			●				●		●			
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●		●	●	●		●			●		●	●	●
Areas of substantial recreational value or opportunity.					●	●	●	●						
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.										●				
Areas of unique geologic or topographic significance to industrial or commercial development.										●				
Areas of urban concentration where shoreline utilization and water uses are highly competitive.														
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.														
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Shrimp nursery.	●		●	●	●		●					●	●	●
Finfish nursery.	●		●	●	●		●			●		●	●	●
Blue crab nursery	●		●	●	●		●					●	●	●
Oyster reef		●									●		●	
Grass flats.				●	●		●			●		●		
Marshes.	●		●	●	●		●							●
Spawning grounds.					●								●	
Water exchange passes.						●		●						
Freshwater input.	●		●											●
Water fowl areas.	●			●	●		●		●		●			●
Endangered species.					●									
Fish-eating bird rookeries.				●	●				●		●			●
Muskrat, otter, and nutria habitats.														
Non-game birds, watching.	●		●	●	●	●	●				●			●

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	71 Oyster reefs in Corpus Christi Bay	72 Oso Bay	73 Water exchange area through Kennedy Causeway	74 Upper Laguna Madre	75 Middle Laguna Madre, Baffin Bay margin	76 Baffin Bay, Laguna Madre - deeper areas	77 Nine Mile Hole	78 Four Mile Slough to Arroyo Colorado	79 Creek west of Four Mile Slough	80 Natural drainage area from Arroyo Colorado	81 Arroyo Colorado to Port Harlingen	82 Cayo Atascosa	83 Mud Hole	84 Gabrielson Is. to Caballo Is.
Areas of National Interest (green ●)	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.	●											●		
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.		●		●	●	●		●	●	●	●	●	●	●
Areas of substantial recreational value or opportunity.	●			●	●	●	●	●			●			●
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.		●												
Areas of unique geologic or topographic significance to industrial or commercial development.														
Areas of urban concentration where shoreline utilization and water uses are highly competitive.														
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.														
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●	●	●	●		●	●	●	●	●	●	●
Shrimp nursery.		●		●	●			●	●	●	●	●	●	●
Finfish nursery.		●		●	●			●			●	●		●
Blue crab nursery		●						●			●	●		●
Oyster reef	●													
Grass flats.				●	●			●				●		●
Marshes.		●		●										
Spawning grounds.				●	●			●						
Water exchange passes.			●				●							
Freshwater input.									●	●	●			
Water fowl areas.		●		●	●			●				●		●
Endangered species.														
Fish-eating bird rookeries.				●	●									
Muskrat, otter, and nutria habitats.														
Non-game birds, watching.		●		●	●									●

JUSTIFICATION AS AN AREA OF PARTICULAR CONCERN	85 Laguna Vista Cove	86 Bay side of southern tip of Padre Island	87 Brazos Santiago Pass	88 Mexiquita Flats	89 South Bay	90 Brownsville Ship Channel ✲	91 Rio Grande to Brownsville	Lee side of Padre Island ✲	Dunes on Padre, Mustang, St. Joseph's Is. ✲	Marshes, rice fields, coastal prairies not on map ✲	USFWS land tracts - Hidalgo County ✲	Rookeries	Waterfowl habitat	Eagle habitat
Areas of National Interest (green ●)	●	●		●	●	●	●	●						
Areas of unique, scarce, fragile, or vulnerable natural habitat, physical feature, historical significance, cultural value, and scenic importance.		●	●	●	●				●		●	●		
Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, and the various trophic levels in the food web critical to their well-being.	●	●		●	●	●	●	●		●	●	●	●	
Areas of substantial recreational value or opportunity.		●	●			●	●		●				●	
Areas especially suited to intensive use or development and where developments and facilities are dependent upon the utilization of, or access to, coastal waters.		●												
Areas of unique geologic or topographic significance to industrial or commercial development.									●					
Areas of urban concentration where shoreline utilization and water uses are highly competitive.														
Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.		●							●					
Areas needed to protect, maintain, or replenish coastal lands or resources.	●	●	●	●	●	●	●		●					
Shrimp nursery.				●	●	●	●							
Finfish nursery.	●	●		●	●	●								
Blue crab nursery	●	●		●	●									
Oyster reef					●									
Grass flats.		●						●						
Marshes.										●			●	
Spawning grounds.		●												
Water exchange passes.			●											
Freshwater input.							●							
Water fowl areas.		●					●	●		●		●	●	
Endangered species.										●	●	●		●
Fish-eating bird rookeries.					●							●	●	●
Muskrat, otter, and nutria habitats.														
Non-game birds, watching.			●		●						●	●	●	●

● Areas of National Interest nominated by National Marine Fisheries Service

✲ Areas treated textually, not located on map

AREAS OF PARTICULAR CONCERN
RECREATIONAL, HISTORICAL, AND WILDLIFE MANAGEMENT AREAS

STATE PARKS
- S1 - Sea Rim
- S2 - Galveston Island
- S3 - Mustang Island

STATE RECREATION AREAS
- S5 - Bryan Beach
- S6 - Goose Island
- S7 - Lake Corpus Christi
- S8 - Brazos Island

STATE HISTORICAL PARKS
- S9 - Sabine Pass Battleground
- S10 - San Jacinto Battleground
- S11 - Varner-Hogg Plantation

STATE HISTORICAL SITES
- S13 - Lipantitlan

STATE HISTORICAL STRUCTURES
- S15 - Port Isabel Lighthouse

STATE FISHING PIERS
- S16 - Port Lavaca
- S17 - Copano Bay
- S18 - Queen Isabella

STATE MANAGEMENT AREAS
- S19 - J. D. Murphree Wildlife Management Area
- S20 - Sheldon Wildlife Management Area
- S21 - Las Palomas Wildlife Management Area
- S22 - Swan Point Fisherman Access Area

NATIONAL PARKS, PRESERVES, REFUGES
- N1 - Padre Island National Seashore
- N2 - Laguna Atascosa National Wildlife Refuge
- N3 - Aransas National Wildlife Refuge
- N4 - San Bernard National Wildlife Refuge
- N5 - Brazoria National Wildlife Refuge
- N6 - Anahuac National Wildlife Refuge

URBAN NATURAL AREAS *
- U1 - Armand Bayou
- U4 - Live Oak Peninsula
- U6 - Prairie Chicken Habitat
- U9 - Upper Buffalo Bayou
- U10 - Pine Island Bayou
- U18 - Lower Sabine Cypress Swamp
- U19 - Banks of Oso Creek
- U25 - Brownsville Whitewing Dove Habitat
- U27 - Bird Flats

RURAL NATURAL AREAS *
- R2 - Loblolly Unit North Extension **
- R6 - Matagorda Island
- R7 - Sandylands Ponds * *
- R8 - Pine Island Bayou
- R11 - Smartt Fire Tower Savannah * *
- R14 - Smith's Woods
- R21 - Marysee Prairie * *
- R23 - Salt Creek Ranch * *
- R46 - Baffin Bay
- R51 - Texas Point Salt Marsh
- R55 - Red Wolf Marshes (see text)
- R56 - Black Rail Salt Marsh
- R57 - Mustang Island Shores
- R59 - Rosehill Pines * *

TRAILS

Existing Trails for a Potential Statewide System ***
- T2 - Galveston Island State Park Trail
- T3 - Padre Island National Seashore Grasslands Trail
- T4 - Aransas National Wildlife Refuge Nature Trails
- T5 - Buffalo Bayou Hike and Bike Trail

AREAS HAVING POTENTIAL FOR FUTURE TRAIL DEVELOPMENT ***
- T8 - Orange County Park
- T9 - Coleto Creek
- T12 - Padre Island National Seashore
- T13 - Lake Houston to Sheldon Reservoir
- T14 - Wild Cow Island

WATERWAYS FOR A POTENTIAL STATEWIDE SYSTEM****
- SW14 - Neches River Scenic Waterway
- SW20 - Sabine River Scenic Waterway
- SW21 - San Bernard River Scenic Waterway

*From: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department

**Not located on map - see Texas Outdoor Recreation Plan

***From: Texas Trailways, A Feasibility Report on a System of Trails in Texas, Texas Parks and Wildlife Department

****From: Texas Waterways, A Feasibility Report on a System of Wild, Scenic and Recreational Waterways in Texas, Texas Parks and Wildlife Department

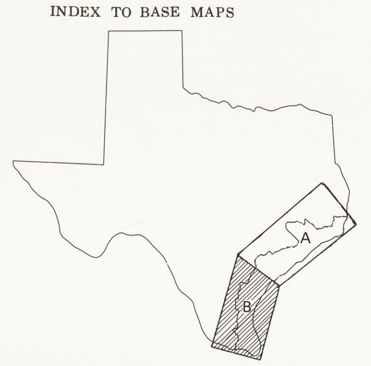
Note: Map units are not numbered sequentially because they are taken from a previously published map (General Land Office of Texas, 1975).

LEGEND
AREAS OF PARTICULAR CONCERN

- 92 — CRITICAL HABITATS
- NATURAL AREAS - Waterfowl Habitats
- NATURAL AREAS - Eagle Habitats
- NATURAL AREAS - Rookery
- T9 — OTHER AREAS

NOTICE: Map information presented herein is generalized. Because of small scale (one inch equals approximately eight miles), many small features do not appear. These maps should, therefore, be used only as a regional overview of resources and not for on-site decision-making. Comments and suggested corrections will be filed for possible future map revisions. Contact: Ron Jones, Director, Coastal Management Program, General Land Office, 1700 N. Congress Avenue, Austin, Texas 78701.

INDEX TO BASE MAPS



CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

AREAS OF PARTICULAR STATE CONCERN
LOWER TEXAS COASTAL REGION 1976

Scale 1:500,000

10 0 10 20 30 40 Statute Miles

10 5 0 10 20 30 40 50 Kilometers

THE STATE OF TEXAS
GENERAL LAND OFFICE
COASTAL MANAGEMENT PROGRAM

PLATE 5A & B
AREAS OF GENERALIZED STATE CONCERN

TEXAS AIR CONTROL BOARD

Four air quality maintenance areas:

- Beaumont Air Quality Maintenance Area (Jefferson County, Orange County, Hardin County);
- Galveston Air Quality Maintenance Area (Galveston County);
- Houston Air Quality Maintenance Area (Harris County, Fort Bend County, Brazoria County, Liberty County, Montgomery County, Waller County);
- Corpus Christi Air Quality Maintenance Area (Nueces County, San Patricio County)

TEXAS DEPARTMENT OF AGRICULTURE

Generalized depiction of extent of citrus, rice, and rangeland (changes seasonally see Pl. 5, A and B);

Areas planted in sugar cane (no map information available)

TEXAS FOREST SERVICE

All lands of the upper coast east of Brazoria and Fort Bend Counties;

Numerous (unmapped) small watershed areas; areas that bear commercial stands of trees;

Watersheds receiving funds under the Federal Watershed Protection and Flood Prevention Act of 1972 (unmapped);

Southeast Texas Resource, Conservation, and Development Project area (unmapped);

De-Go-La Resource, Conservation, and Development Project area (unmapped)

TEXAS HIGHWAY DEPARTMENT

All state maintained, federal, and interstate highway routes and rights-of-way; especially noteworthy are routes that may serve as evacuation corridors in event of emergencies (unmapped - see county highway maps)

TEXAS INDUSTRIAL COMMISSION

Industrial sites; Multi-model transportation corridors - highway, rail, and canal; Deepwater port facilities - maintenance and development; Mineral resource areas; Coastal wetlands (see Pl. 9, A and B; Pl. 7, A and B; Pl. 6, A and B)

TEXAS WATER RIGHTS COMMISSION

County-by-county enumeration of:

9 — Water districts;

1 — Dams and reservoirs with maximum capacity greater than 200 acre-feet;

14 — Number of permits, claims, and certified filings per county

Note: detailed site-specific maps were submitted by Texas Water Rights Commission

TEXAS WATER QUALITY BOARD

Stream segments designated as Water Quality Segments

Areas designated as "Section 208 areas" (More precise maps showing "208 areas" can be obtained from Texas Water Quality Board, Austin; Southeast Texas Regional Planning Commission, Nederland; Houston-Galveston Area Council of Governments, Houston; Coastal Bend Council of Government, Corpus Christi; and Lower Rio Grande Valley Development Council, McAllen)

Areas in which a TWQB order has been issued regarding use of septic tanks and other private sewage facilities

THE UNIVERSITY OF TEXAS, BUREAU OF ECONOMIC GEOLOGY

All coastal waters, designated as areas of interest for research (not delineated on map)

TEXAS HISTORICAL COMMISSION

Coastal waters - submerged land outward to a depth of 30 feet, or out to the three league line along ancient river courses

All water courses on uplands (unmapped)

All recorded archaeological sites; historical markers and sites listed on National Register of Historic Places (see Pl. 8, A and B)

TEXAS SOIL AND WATER CONSERVATION BOARD

All lands of the region (entire map area - - no specific delineation)

TEXAS DEPARTMENT OF HEALTH RESOURCES

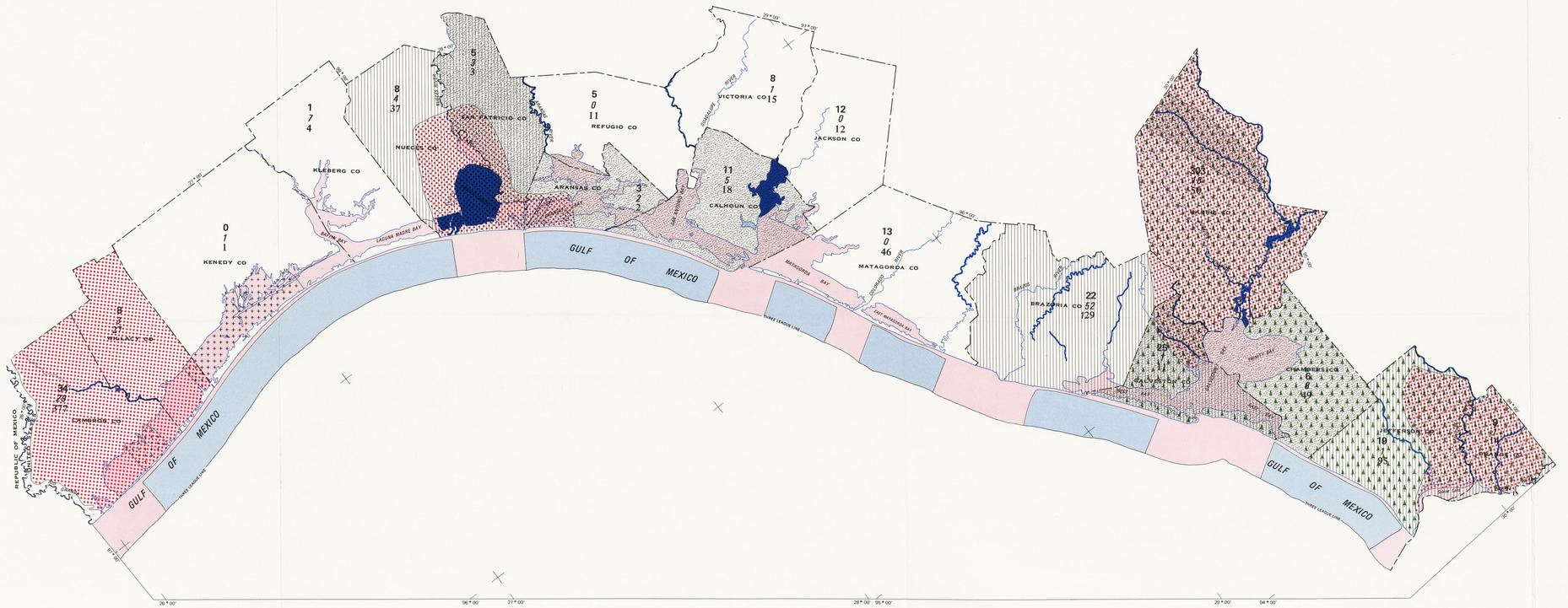
Polluted areas closed to shellfish harvesting. See Maps of classification of shellfish harvesting areas from the Division of Shellfish Sanitation Control

GENERAL LAND OFFICE

Selected tidelands in Laguna Madre where ownership is contested; All other tidelands in which ownership may be contested

No responses received from the following agencies and institutions:

- RAILROAD COMMISSION
- TEXAS A & M UNIVERSITY
- TEXAS WATER DEVELOPMENT BOARD



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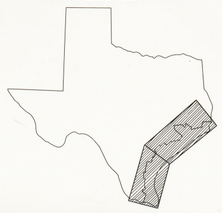

CARTOGRAPHIC PRESENTATION AND PRINTING BY
INTERNATIONAL AERIAL MAPPING COMPANY
SAN ANTONIO, TEXAS 78216

AREAS OF GENERALIZED STATE CONCERN
UPPER & LOWER TEXAS COASTAL REGION 1976

Scale 1:1,000,000

20 0 20 40 60 80 Statute Miles

20 10 0 20 40 60 80 100 Kilometers